FIRE, SMOKE AND RADIATION DAMPER INSTALLATION GUIDE FOR HVAC SYSTEMS

SHEET METAL AND AIR CONDITIONING CONTRACTORS'
NATIONAL ASSOCIATION, INC.

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FIFTH EDITION, SEPTEMBER 2002

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4201 Lafayette Center Drive

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FOREWORD

Since the publication of the first edition of this "Fire, Smoke, and Radiation Damper Installation Guide for HVAC Systems," many changes have occurred in concepts of fire protection. Emphasis on use of duct systems in engineered smoke control modes as outlined in ASHRAE and National Fire Protection Association (NFPA) publications is now a key consideration for HVAC system designers. Such concepts depart from the traditional practice of automatic shutdown of duct systems and create new perspectives on the role of fire and smoke dampers. In some cases dampers are serving the dual role of fire dampers and smoke dampers.

This edition of the guide again reemphasizes the segregation of the responsibilities that architects, engineers, contractors, manufacturers, testing agencies and local authorities have regarding fire and smoke dampers. Industry is encouraged to use more standardization in the basic elements of installation and in the preparation of installation instructions.

The details shown in this guide represent the state-of-the-art of the dampers manufactured by those in the HVAC industry, and may be modified by individual manufacturers to meet specific requirements. These dampers must be installed as outlined and shown by the manufacturers' installation instructions which result from UL testing. In addition to UL labels or UL listing, some local and state authorities will require approval or compliance with local codes before allowing use.

This guide contains descriptions, illustrations, recommendations on changes in industry practices, suggestions on disposition of installation detail for situations not confirmed by fire tests in composite assemblies, designations of responsibility, references to the other documents, check lists, and guidance on plan marking. Thus, it is essentially a generic guide of commercially available products that should not be categorically referenced in codes or project specifications.

The Committee expresses its appreciation to the National Fire Protection Association (NFPA) for their contributions to this manual.

SHEET METAL AND AIR CONDITIONING CONTRACTORS'
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CHAPTER 1

PURPOSE AND SCOPE

1.1 PURPOSE

The purpose of this guide is to outline the considerations in specifying and installing fire dampers, smoke dampers, combination fire and smoke dampers and ceiling dampers in HVAC systems; provide contractors, system designers, and code officials with an understanding of their respective responsibilities as mandated by the model codes; and illustrate the use of specific methods of application in HVAC systems.

1.2 SCOPE

This guide reviews the pertinent language contained in the model codes, the terminology used in the codes and other relevant documents, and the requirements of plans and specifications as: (1) developed by architects, engineers, and systems designers; (2) reviewed by code officials; and (3) installed by contractors. In addition, this guide will illustrate specific methods for installing fire dampers, smoke dampers and ceiling dampers for HVAC systems.

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CHAPTER 2

INTRODUCTION AND TERMINOLOGY

2.1 BACKGROUND

The control of fire and smoke is a major concern in the building codes. The model codes have extensive treatment of these issues from an overall building construction viewpoint. They contain many requirements and construction techniques intended to limit or control the spread of fire and smoke within a building. These techniques or methods include fire suppression systems (sprinklers), smoke management and control systems, and the construction of walls, floors, partitions, ceiling assemblies, etc., designed to limit the spread of fire and smoke.

In virtually every building, the installation of HVAC and electrical systems requires the penetration of fire-resistive assemblies by ducts, pipes, conduit, cables, etc. All model codes mandate the maintenance of fire-resistance rating of those assemblies (walls, floors, etc.) when they are penetrated in the course of the installation of HVAC and electrical services. The codes, however, do not prescribe or dictate how these penetrations are to be protected. The responsibility for the specification of the details (materials and methods) is delegated to the design professionals.

2.2 TERMINOLOGY

Area Separation Wall. A wall of fire-rated construction (expressed in hours) which serves to divide the floor area of a building into acceptable area limits as set forth in the applicable code.

Breakaway Connection. A joint connecting a fire damper sleeve and attached duct work which will allow collapse of the duct work during a fire without disturbing the integrity of the fire damper.

Draft Stop. A continuous membrane used to subdivide a concealed space to restrict the passage of smoke, heat, and flames.

Fire Damper. A normally open damper installed in an air distribution system designed to close automatically upon the detection of heat, to interrupt migratory air flow, and to restrict the passage of flames.

Fire dampers are evaluated for use in either of the following conditions:

a. Static application — For HVAC systems that are automatically shut down in the event of a fire or for air transfer openings in walls or partitions.

b. Dynamic applications — For HVAC systems that are operational in the event of a fire.

The device has been tested in accordance with a standard for safety by a recognized testing laboratory and is identified by a label affidavit for listing acceptable to the authority having jurisdiction. *(Unless the conditions of approval so indicate, they are not rated for closing against moving air streams or withstanding pressure differentials.)*

A combination fire and smoke damper must meet the requirements of a fire damper test standard and a smoke damper test standard.

Fire Damper Sleeve. A steel enclosure surrounding a fire damper, in an air passage penetrating a fire rated barrier mounted in such a manner that disruption of attached ductwork, if any, will not impair operation of the fire damper. (*Some publications refer to such sleeve as a "collar").* Sleeves may be omitted on certain alternative damper arrangements that are in compliance with UL 555, Standard for Fire Dampers.

The damper manufacturers Installations and Operating Instructions shall state whether sleeves may be omitted.

Fire Rated Ceiling. A ceiling tested for fire resistance as part of a floor-ceiling, roof-ceiling or floor-ceiling-wall assembly.

Fire Rated Partition. A partition having an assembly of materials that will afford a given fire resistance rating (expressed in hours) to impede the spread of fire from one area to another.

Fire Wall. A fire resistance rated wall, having protected openings, that restricts the spread of fire and extends continuously from the foundation to or through the roof, with sufficient structural stability under fire conditions to allow collapse of construction on either side without collapse of the wall.

Floor-Ceiling or Roof-Ceiling Assembly. A form of construction comprised of floor-ceiling or roof-ceiling as an assembly which, when fire tested as a unit, has been assigned a fire endurance rating expressed in hours. Commonly termed a floor-ceiling assembly.

Heat Responsive Link. A device that holds a fire damper or fire door in an open position until a designated ambient temperature is reached, wherein the fire damper or door is released to close. The device may be a soldered type, strut type, glass bulb type or bi-metallic metal as designed by UL 33, Standard for Heat Responsive Links for Fire-Protection Service.

Heat Stop. A method by which temperature rise is retarded for ceiling openings in a fire rated floor-ceiling or roof-ceiling assembly. (Commonly used methods are ceiling dampers, hinged damper at duct collar inlet, UL Fire Resistance Directory Protection Systems A and B, and duct outlet protection covers. *See* Figures 7-1 through 7-4)

Mullion, Damper. A separate steel member or members used to join dampers in a multiple damper opening, either horizontally or vertically.

Occupancy Separation. A wall, partition, floor-ceiling assembly, or roof-ceiling assembly, of fire-rated construction, so located as to separate or partition off portions of a building having different fire potentials or safety requirements based on the use or occupancy of such areas.

Radiation Damper. A specialized form of a heat stop installed in the air distribution portion of a fire-rated floor-ceiling or roof-ceiling assembly; the sole purpose of which is to help maintain the fire endurance rating of the assembly. (See test methods in UL 555C, Second Edition; see listings in the UL Resistance Directory and those of other listing or approving authorities.)

Smoke Barrier. A continuous membrane, either vertical or horizontal, such as a wall, floor or ceiling assembly, that is designed and constructed to restrict the movement of smoke. A smoke barrier may or may not have a fire resistance rating. Such barriers may have protected openings.

Smoke Control Zone. A space within a building enclosed by smoke barriers or fire barriers on all sides, including the top and bottom, that is part of a zoned smoke-control system.

Smoke Damper. A smoke damper is a device to resist the passage of smoke which:

a. Is arranged to operate automatically.

b. Is controlled by smoke detection.

c. May be required to be positioned manually from a remote command station.

d. Is rated for leakage at specified static pressure ranges and may have a temperature rating.

e. May be rated as a volume control damper, in which case it shall be so marked.

A smoke damper may be a fire damper or a damper serving other functions, if its location lends itself to the multiple functions. A combination fire and smoke damper shall meet the requirements of both test standards.

Some smoke dampers are rated for use as volume control dampers. They will be so marked.

Smokeproof Enclosure. As defined by the NFPA 101, Life Safety Code, a stair enclosure is designed to limit the movement of products of combustion produced by a fire. The smokeproof enclosure must be a continuous stair enclosed from the highest point to the lowest point, enclosed by two-hour rated fire barriers.

Zoned Smoke Control. A smoke-control system that includes smoke exhaust for the smoke zone and pressurization for all contiguous smoke-control zones. The remaining smoke-control zones in the building also may be pressurized.

CHAPTER 3

CODES AND REGULATIONS

3.1 CODE AUTHORITIES

Fire-resistive construction requirements usually are determined by the local or state code authority. Local and state codes are usually adaptations of the national and model codes, such as the *International Building Code*, published by the International Code Council, Inc. (ICC); *BOCA National Building Code* published by the Building Officials and Code Administrators International, Inc. (BOCA); the *Uniform Building Code* published by the International Conference of Building Officials (ICBO); and the *Standard Building Code* published by the Southern Building Code Congress International, Inc. (SBCCI). In addition to the building codes referenced above, mechanical codes contain the language and requirements for dampers.

State fire marshals and local fire departments often have specific fire code requirements on construction and ventilation, especially for treatment of hazardous material storage, processes, high life hazard occupancies, etc.

All agencies or authorities having jurisdiction should be consulted by the architect, engineer, or system designer before final plans are drawn for fire-resistive requirements and for hourly fire-resistive ratings of floors, walls, partitions, other assemblies and for protection of penetrations and openings. This includes through stop penetration, fire doors, fire dampers, and smoke dampers.

The National Fire Codes published by the National Fire Protection Association (NFPA) contain recommended practices and technical data for determining fire-resistive requirements. Standards for fire-resistive tests may be found through the American National Standards Institute (ANSI), ASTM, UL, and the NFPA.

Testing of fire-resistive components and assemblies may be conducted by any of several independent testing laboratories. The most prominent testing laboratories evaluating fire resistive materials and assemblies are UL and UL of Canada.

3.2 CODE REQUIREMENTS

3.2.1 General

The NFPA *Standard for the Installation of Air-Conditioning and Ventilating Systems*, NFPA 90A, is the basis of the model code requirements for fire protection of air duct systems. In addition to specific requirements in building and mechanical codes, many code officials apply the requirements in NFPA 90A or use it as a reference source for requirements where the local code is silent. In particular, NFPA 90A is regarded as the primary source for locating dampers in air distribution systems.

All model codes contain specific requirements and language addressing fire-resistant construction. These requirements, which may be entire chapters of building codes and sections of chapters in the mechanical codes, generally prescribe the details of fire-resistant construction. However, the language that mandates the requirements of plans and specifications and the responsibilities of the code official in the review process of plans and specifications resides in the administrative sections of the model codes. Excerpts of those paragraphs are shown here with the appropriate section and paragraph numbers noted. This text is presented exactly as it appears in the model codes including italics.

3.2.1.1 National Fire Protection Association

STANDARD FOR THE INSTALLATION OF AIR-CONDITIONING AND VENTILATION SYSTEMS, NFPA 90A – 1999

Chapter 3 Integration of a Ventilation And Air-Conditioning System(s) with Building Construction

3-4 Fire Dampers, Smoke Dampers, And Ceiling Dampers

3-4.6 Installation. See 2-3.4 for access.

3-4.6.1 The locations and mounting arrangement of all fire dampers, smoke dampers, ceiling dampers, and fire protection means of a similar nature required by this standard shall be shown on the drawings of the air duct systems.

3.2.1.2 International Conference of Building Officials (ICBO)

UNIFORM BUILDING CODE—1997

Chapter 1—ADMINISTRATION

SECTION 106 — PERMITS

106.3 Application for Permit

106.3.3 Information on plans and specifications. Plans and specifications shall be drawn to scale upon

substantial paper or cloth and shall be of sufficient clarity to indicate the location, nature and extent of the work proposed and show in detail that is will conform to the provisions of this code and all relevant laws, ordinances, rules and regulations.

Plans for buildings other than Group R, Division 3 and Group U Occupancies shall indicate how required structural and fire-resistive integrity will be maintained where penetration will be made for electrical, mechanical, plumbing and communication conduits, pipes and similar systems.

UNIFORM MECHANICAL CODE–1997

Chapter 1—ADMINISTRATION

SECTION 113 —APPLICATION FOR PERMIT

113.3 Information on Plans and Specifications. Plans and specifications shall be drawn to scale upon substantial paper or cloth and shall be of sufficient clarity to indicate the location, nature and extent of the work proposed and show detail that it will conform to the provisions of this code and relevant laws, ordinances, rules and regulations.

113.3.1 Penetrations detailed. Plans for buildings more than two stories in height of other than Group R, Division 3 and Group U occupancies shall indicate how required structural and fire-resistive integrity will be maintained where a penetration will be made for electrical, mechanical, plumbing and communication conduits, pipes and similar systems.

3.2.1.3 Building Officials and Code Administrators International, Inc. (BOCA)

BOCA NATIONAL BUILDING CODE—1999

Chapter 7—FIRE-RESISTANT MATERIALS AND CONSTRUCTION

SECTION 703.0 CONSTRUCTION DOCUMENTS

703.1 General: *Construction documents* for all buildings shall designate the type of construction and the fire-resistant rating of all structure elements as required by this code. The *construction documents* shall include documentation or supporting data substantiating all required fire-resistance ratings including details and materials for providing the required fire-resistant rating at *joints* and penetrations of fire-resistant rated assemblies. The *construction documents* shall also indicate details and methods for *fireblocking*.

703.2 Penetrations: *Construction documents* for buildings more than two stories in *height* shall indicate where penetrations will be made for electrical, mechanical, plumbing and communication conduits, pipes and systems.

3.2.1.4 Southern Building Code Congress International (SBCCI)

STANDARD BUILDING CODE—1997 AND STANDARD MECHANICAL CODE—1997

Chapter 1—ADMINISTRATION

SECTION 104—PERMITS

104.2 Drawings and Specifications

104.2.1 Requirements. When required by the building official, two or more copies of specifications, and of drawings drawn to scale with sufficient clarity and detail to indicate the nature and character of the work, shall accompany the application for a permit. Such drawings and specifications shall contain information, in the form of notes or otherwise, as to the quality of materials, where quality is essential to conformity with the technical codes. Such information shall be specific, and the technical codes shall not be cited as a whole or in part, nor shall the term "legal" or its equivalent be used as a substitute for specific information. All information, drawings, specifications and accompanying data shall bear the name and signature of the person responsible for the design.

104.2.4 Structural and fire resistance integrity. Plans for all buildings shall indicate how required structural and fire resistance integrity will be maintained where a penetration of a required fire resistant wall, floor or partition will be made for electrical, gas, mechanical, plumbing and communication conduits, pipes and systems. Such plans shall also indicate in sufficient detail how the fire integrity will be maintained where required fire resistant floors intersect the exterior walls and where joints occur in required fire resistant construction assemblies.

3.2.1.5 International Code Council

INTERNATIONAL MECHANICAL CODE—2000

Chapter 1 — ADMINISTRATION

SECTION 106 — PERMITS

Para. 106.3 Application for Permit.

> **106.3.1 Construction Documents.** Construction documents, engineering calculations, diagrams and other data shall be submitted in two or more sets with each application for a permit. The code official shall require construction documents, computations and specifications to be prepared and designed by a registered design professional when required by state law. Construction documents shall be drawn to scale and shall be of sufficient clarity to indicate the location, nature and extent of the work proposed and show in detail that the work conforms to the provisions of this code. Construction documents for buildings more than two stories in height shall indicate where penetrations will be made for mechanical systems, and the materials and methods for maintaining required structural safety, fire-resistance rating and fireblocking.

3.3 BUILDING/CODE OFFICIALS

From the above, it is clear that the plans and specifications submitted with the application for permit are intended to describe *graphically, in detail* the work to be done. Other language in these code sections mandates that the building official review the plans and specifications filed with the application for permit to determine or verify that those plans and specifications are in compliance with the code. This review is not discretionary, and failure to do so is a violation of the code.

3.4 FIRE RESISTIVE REQUIREMENTS

The hourly ratings and locations of fire-resistive separations are usually determined by authorities having jurisdiction, based on the requirements of the applicable building code. Occupancy of individual building spaces determines the fire endurance rating required to enclose the space. The occupancy definitions and requirements of the four model codes are similar. Local codes may have different occupancy definitions and requirements; however, the differences are usually slight. Each code should be checked with the local jurisdiction.

Separations may be classified as Fire Walls, to completely separate buildings; Area Separations, to subdivide large floor areas of buildings; and Fire Resistant Partition, to separate occupancies of different fire-resistive requirements. This Guide uses these terms; however, different terms describing the same basic purpose may be found in various codes. In every building, a determination of the required fire endurance rating and required separations must be made.

The location of the building in relation to the property line must also be considered since a fire in one building also provides an exposure to adjacent buildings, thus, in some jurisdictions requiring a fire damper in openings to the outside. Building openings in some jurisdictions may require fire dampers if an opening in the same building provides a hazard to adjacent openings in the buildings.

In every case, the most restrictive requirement should be applied. A corridor wall may normally be required to have a one-hour fire endurance rating; however, it might separate an area which would require it to have a higher fire endurance rating.

If the building is equipped with a complete automatic fire extinguishing system, the fire-resistive requirements of floors, walls, and roofs are sometimes reduced. Local codes should be consulted before proceeding on this assumption.

3.5 FIGURES, DETAILS AND DESCRIPTIONS IN THIS GUIDE

Fire, smoke and radiation dampers and heat stops should be installed within the conditions of their UL listing. The information and drawings in this guide are presented primarily to illustrate the elements of installation. They are intended to represent non-proprietary products and methods except in the sense of acknowledging that conditions of listing or approval may be proprietary. They do not represent the full spectrum of products and methods available in the industry. They are intended to encourage standardization in installations and to call attention to the appropriate segregation of responsibilities of those concerned with installations. Where an element of an installation is not addressed by a condition of approval and listing, the illustrations may assist a local authority in judging adequacy and comparability.

Changes must not be made from the installation drawings and instructions of UL Listed fire dampers, smoke dampers, or ceiling radiation damper assemblies by local or state authorities. Changes that result in equipment or system failures might

create a liability to all parties involved in the changes.

3.6 FIRE AND SMOKE DAMPER TESTING

There are two basic fire tests referenced in NFPA 90A which involve the acceptance of fire dampers. Testing of smoke dampers is referenced in NFPA 92A.

Fire dampers having ratings specified in hours, commonly 1½ hours and 3 hours. Fire doors are rated for ⅓, ½, ¾, 1, 1½, and 3 hours per the wall opening classification in NFPA 80. Door or damper ratings required by code provisions, may not match wall or partition ratings. Fusible links are normally 160°F to 165°F minimum, but approximately 50°F above system operating or shutdown temperature. Follow applicable specifications. See UL 33. Other type links are available.

UL 555, *Fire Dampers and UL 555C Ceiling Dampers*, and UL 10B, *Fire Tests of Door Assemblies*, (or ASTM Standard E 152 or NFPA 252 of the same title) involve fire tests where heat transmission or temperature rise is not a consideration or condition of acceptance (out of wall damper testing to UL 555 does involve heat transmission or temperature rise). Fire dampers are tested independently and are also subject to dust loading, salt spray exposure corrosion resistance, spring closing force, etc. Effective April 1, 1992, all fire dampers **must be labeled** to indicate if they are used in static or dynamic systems. For dynamically rated dampers, this label must also indicate maximum rated velocity through the open damper, and the maximum pressure differential across the closed damper.

Ceiling dampers are listed in UL's *Fire Resistance Directory.*

UL Standard 555S, *Leakage Rated Dampers for Use in Smoke Control Systems* covers leakage rated dampers intended for use in heating, ventilating, and air conditioning (HVAC) systems. Leakage rated dampers are intended (1) to restrict the spread of smoke in HVAC systems that are designed to be automatically shut down in the event of fire or (2) to control the movement of smoke within a building when the HVAC system is operational in engineered smoke control systems.

These leakage rated dampers are intended for installation and use in accordance with the *Standard for Installation of Air Conditioning and Ventilating Systems*, NFPA 90A.

See Appendix A.

CHAPTER 4

PLANS AND SPECIFICATIONS RESPONSIBILITIES

4.1 ARCHITECTS

The architect is responsible for the design of fire-resistive walls, floor-ceiling assemblies, roof-ceiling assemblies, and the protection of openings therein as well as the horizontal and vertical smoke barriers. In their consideration for fire protection, architects first must determine the function of the structure, and the type of occupancy of its individual spaces. Those spaces in the building which are required to be separated by fire-resistive assemblies with protected openings are described in the building code which pertains to the jurisdiction in which the building is to be erected. Architects should determine the authority having jurisdiction at the building site, and they should comply with any special conditions of fire protection design required by that authority.

The architect should show the necessary horizontal and vertical fire separations and the hourly requirements of the fire separation on the floor plans and in the building sections. A fire-resistive assembly, such as that shown in the UL Fire Resistance Directory, should be identified by its design number or specification as well as by its hourly rating. The HVAC system designer can then determine the maximum ceiling opening permitted in the assembly and the type of opening protection, if required.

The architect should specify that the wall, ceiling, and floor systems contractor(s) provide access openings in building structures that are of a size and location adequate for access to fire dampers by maintenance personnel.

It is important that the architect clearly identify all fire-resistant assemblies and their hourly ratings on the drawings.

4.2 ENGINEERS/SYSTEM DESIGNERS

The engineer or system designer is responsible for knowing where ducts, pipes, and other conduits pierce required fire-rated separations or smoke barriers. Duct penetrations must be shown on the mechanical plans and designed with a required protection method. Use of standard symbols for the method is highly recommended. NFPA 90A states that the designer must show on the plans, the location and mounting details of all automatic fire doors, fire dampers, smoke dampers; ceiling radiation dampers and other fire protection means incorporated in an HVAC system. The engineer should specify leakage sealed casings and sleeves consistent with the duct pressure class and allowable leakages.

Only engineers/system designers are in possession of sufficient information on barrier locations, occupancy assignments, protection planning, and rating and identification of compartments and structural components to coordinate all requirements.

In addition to showing fire dampers, smoke dampers, and heat stops on the drawings, the engineer/designer should specify an hourly rating for the damper, the type of damper and requirements for access doors; and there should be coordination with local authorities to verify acceptance of the methods and equipment to be used. Thickness and type of fire resistive material may vary with the jurisdiction. Special framing requirements of openings should be provided in the architectural and structural drawings that are submitted for building permits.

It is important that the system designers clearly identify on the project drawings all duct penetrations of fire-resistive assemblies and the details and methods to install the required dampers to maintain the fire-resistive integrity of those assemblies.

4.3 MASTERSPEC AND SPECTEXT

AIA's MASTERSPEC and CSI's SPECTEXT list fire dampers under "Ductwork Accessories". MASTERSPEC recommends that "each ductwork accessory" be shown on the drawings and SPECTEXT recommends that "all fire dampers be indicated" on the drawings.

4.4 BUILDING CODE OFFICIALS

Building/code officials are responsible for reviewing the plans and specifications for compliance with local codes. Among other considerations, the code official should verify that the drawings clearly identify the required aspects of fire-resistant construction—including designation of all fire-resistive partitions and assemblies—*and* that the drawings and specifications clearly identify all penetrations of those assemblies *and* detail the required materials and methods for the protection of those penetrations. This review of the plans and specifications is required by the codes, and if during this review, the code official determines that the required information is not complete or is in violation of the code he should return the documents to the designers for correction and withhold the issuance of the permit.

It is mandatory that the plans and specifications completely identify all fire-resistant assemblies, and the details of how those penetrations are to be protected.

It is the responsibility of the code official to determine that the required information is contained in the construction documents.

4.5 HVAC CONTRACTORS

The HVAC contractor is not responsible for the quantity and location of fire, smoke, and ceiling radiation dampers and heat stops.

The HVAC contractors are required to install the specified dampers as detailed on the construction documents. This includes fire dampers, smoke dampers, combination fire and smoke dampers, and radiation dampers at those locations where ducts penetrate fire-resistive assemblies *and* are clearly indicated on the drawings.

The HVAC contractor shall install the specified fire, smoke and radiation dampers, and ceiling opening protections where shown on the engineer's or system designer's plans.

The HVAC contractor shall furnish duct access doors of sufficient size and in a location to provide access to the linkage and catch of the dampers to permit inspection, and to allow servicing and resetting.

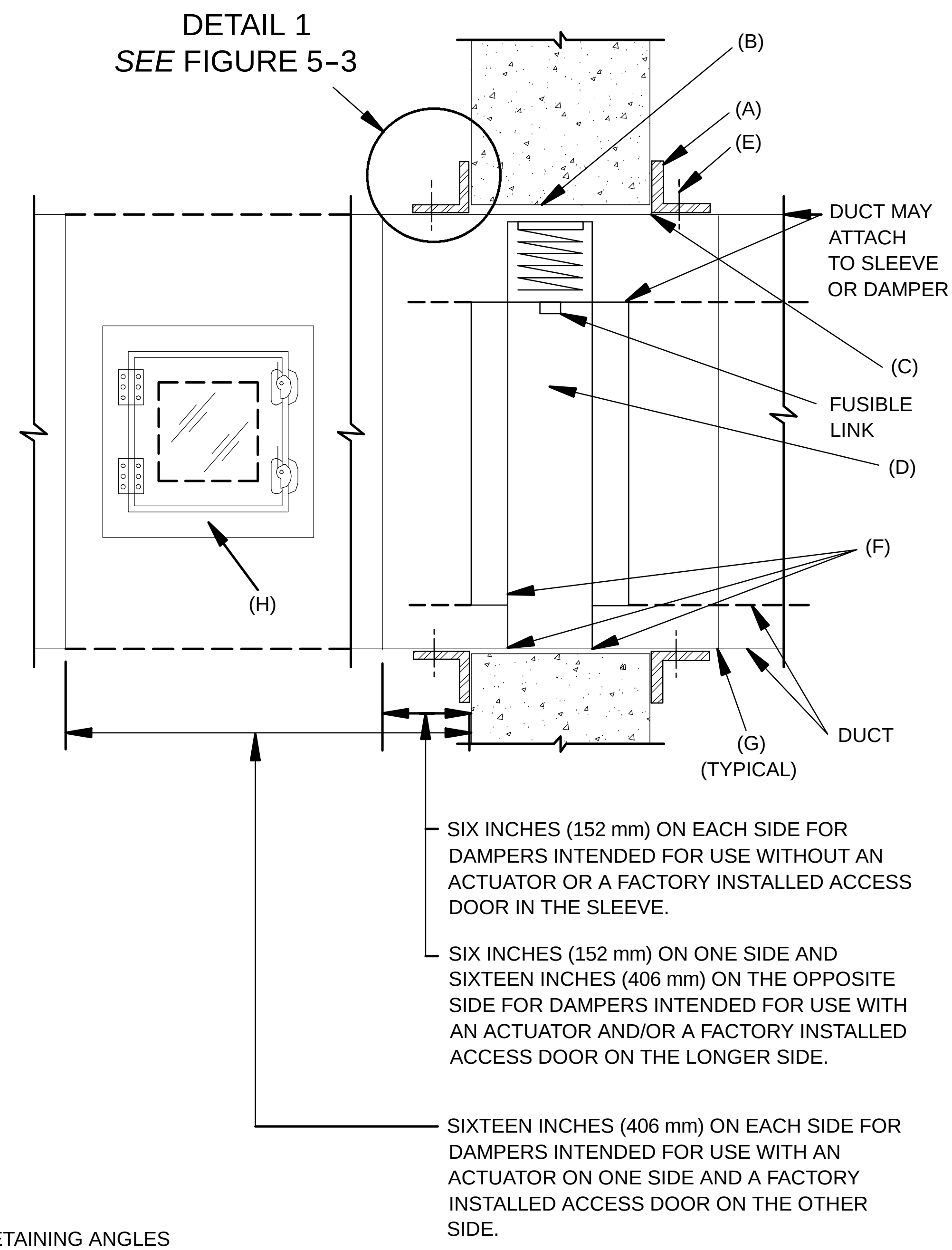
The HVAC and electrical contractors are not responsible for the quantity, location, and details of producing or maintaining the details of producing or maintaining the required fire-resistance ratings of assemblies penetrated by the materials and systems installed by their trades, except as those quantities and details are shown on the drawings and in the specifications.

CHAPTER 5

FIRE DAMPER INSTALLATION

Item	Manufacturer Information to be Provided
1. Damper	a. function b. static or dynamic c. make (mfr.) d. model number
2. Fire Resistance Rating	a. time in hours
3. Approval	a. testing or listing agency
4. Sleeve	a. material b. thickness c. length (maximum) d. maximum distance of sleeve termination from wall (see UL 555)
5. Duct-to-Sleeve (or Frame) Connection	a. method(s) b. locations
6. Damper Attachment to Sleeve	a. method(s) b. locations
7. Retaining Angle	a. size b. material c. fastener locations
8. Maximum Rated Size of Damper	a. dimension
9. Assembly of Multiple Sections	a. methods b. fastener locations
10. Airflow	a. maximum velocity rating b. static pressure rating
11. Damper Orientation for Proper Closure	a. position
12. Illustrations	a. installation arrangement b. clearance category
13. Any Construction Detail Contingent on Approval for Listing by a Rating Authority	a. pertinent data (*e.g.* fusible link rating, opening framing provisions, etc.)

Table 5-1 Required Fire Damper Installation Instructions



A – RETAINING ANGLES
B – EXPANSION SPACE
C – DAMPER SLEEVE
D – FIRE DAMPER/ COMBINATION FIRE/SMOKE DAMPER
E – RETAINING ANGLES FASTENED TO SLEEVE
F – DAMPER ATTACHMENT TO SLEEVE
G – CONNECTION TO DUCT
H – ACCESS DOOR OR PANEL

FIGURE 5-1 BASIC FIRE DAMPER INSTALLATIONS

BASIC FIRE DAMPER INSTALLATION DETAILS – NOTES TO FIGURE 5–1

The following notes are generally applicable to most fire damper/combination fire/smoke damper installations. These details may vary by manufacturer and SHOULD NOT be used as the basis of a damper installation. **THE MANUFACTURER'S INSTALLATION INSTRUCTIONS MUST BE USED AS THE BASIS FOR ALL DAMPER INSTALLATIONS.**

A. RETAINING ANGLES

1. Minimum 1½ × 1½ × 16 ga (40 × 40 × 1.6 mm)
    a. Retaining angles must overlap structure opening 1 inch minimum and cover corners of openings.
    b. 16 gage is the most commonly used thickness for the retaining angles. However manufacturers may allow lighter gage angles on some smaller dampers and may require heavier gage angles on larger dampers. Consult the manufacturer's installation instructions for specifics.

B. EXPANSION SPACE

1. Fire Damper Sleeve Clearance within Wall/ Floor Opening
    a. Minimum ⅛ inch per linear foot (10 mm per linear meter) of damper — both dimensions. (¼" (6 mm) minimum)
    b. Clearance requirements for damper sleeves within a wall opening are based on ⅛ inch per foot (10 mm per meter) of width (or height) unless otherwise stated in the listing of the assembly. The sleeve may rest on the bottom of the opening, and need not be centered. (Fractional dimensions shall be taken as the next largest whole foot.)

Example: A 30 inch × 24 inch fire damper sleeve is installed in a wall opening. The opening shall be 30⅜ inches wide (⅛ inch × 3 feet) by 24¼ inches high (⅛ inch × 2 feet).

The sleeve is retained in the wall/floor by use of steel retaining angles (A).

The dimensions required for the opening shall be those remaining after the opening has been framed and fire resistive materials provided where required (see Figure 6-1). The fire resistive material shall be equal to the requirements for fire resistive material used in the constructed wall so that a continuous rating exists at the wall penetration. The contractor erecting the wall is responsible for providing the fire resistive material and correct size opening to achieve the required clearance.

    c. The clearance may be greater than the ⅛ inch per foot (10 mm per meter) of damper as allowed by damper manufacturers installation instructions. Consult with manufacturers for maximum allowable.

C. DAMPER SLEEVE

1. Steel Sleeve, see Table 5-2 for details

D. FIRE DAMPER/COMBINATION FIRE/ SMOKE DAMPER

1. Approved Fire Damper — Curtain or multi-blade type

E. RETAINING ANGLES FASTENED TO SLEEVE

1. Secure Retaining Angles to Sleeve ONLY on 8"centers (203 mm) with:
    a. ½" (12 mm) long welds
    b. ¼" (6 mm) bolts and nuts
    c. No. 10 Sheet Metal Screws
    d. Minimum 3⁄16" (5 mm) steel rivets
    e. *Note:* The size and spacing requirements may differ by damper manufacturer. Consult manufacturer's installation instructions for specifics.

F. DAMPER ATTACHMENT TO SLEEVE

1. Secure Damper to Sleeve on 8" centers (203 mm) with:
    a. ½" (12 mm) long welds
    b. ¼" (6 mm) bolts and nuts
    c. No. 10 Sheet Metal Screws
    d. Minimum 3⁄16" (5 mm) steel rivets

See note in Item E above.

G. CONNECTION TO DUCT

1. Connect Duct to Sleeve as shown in Table 5-2 and as indicated in Figure 5-2.

H. ACCESS DOOR OR PANEL

1. Install as shown in Figure 5-1.

Type of Connection	Duct	Duct Dimension	Sleeve Gage
Rigid	Round – Rectangular	24 in. (610 mm) maximum diameter 24 in. (610 mm) maximum height and 36 in. (915 mm) maximum width	16[+] (1.613[+] mm)
Rigid	Round – Rectangular	over 24 in. (610 mm) diameter over 24 in. (610 mm) height and over 36 in. (915 mm) width	14[+] (1.994[+] mm)
Breakaway (*See* Figure 5-2 on pages 5.5 and 5.6)	Round or Rectangular	12 in. (305 mm) and down 13 – 30 in. (330 – 760 mm) 31 – 54 in. (785 – 1370 mm) 55 – 84 in. (1400 – 2130 mm) 85 in. (2160 mm) and up	26 (0.55 mm) 24 (0.70 mm) 22 (0.85 mm) 20 (1.0 mm) 18 (1.3 mm)

By UL 555, all ducts are required to terminate at the fire damper sleeves or the damper frames. Sleeve thickness is contingent on the type of connection. All UL listed dampers also have maximum dimensions associated with the test rating. Contingent on sleeve thickness a rigid connection may be used in lieu of a breakaway connection. Sleeves may be omitted where dampers are designed to be in non-ducted air passages or where damper housing permits attachment of retaining angles to the housing. Attachment of retaining angles must not restrict operation of the fire damper. Certain UL approved designs do not require retaining angles.

Where the fire damper sleeve is exposed to the airstream, the metal sleeve will be of the same material as the duct system. A steel sleeve, of the type or finish specified by the system designer, will be used for fibrous glass ductwork and where the fire damper sleeve is not exposed to the airstream.

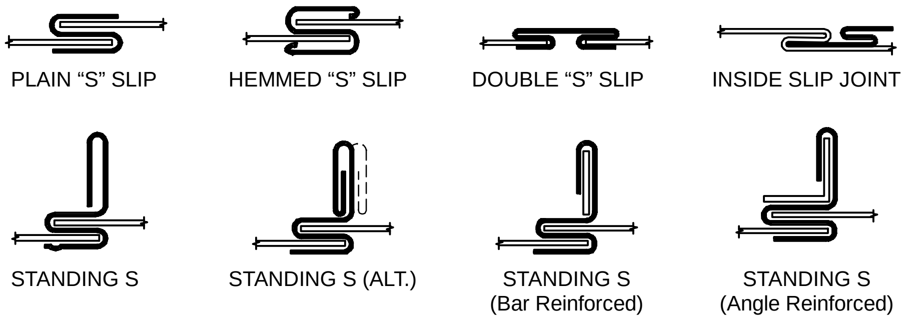
Table 5-2 Recommended Minimum Sleeve Thickness for Fire Dampers[*]

NOTES:

[+] Breakaway connection not required.

[*] *See* Figure 5-2, pages 5.5 and 5.6, for details and exceptions.

1. DUCT-SLEEVE CONNECTIONS LISTED IN UL 555, SIXTH EDITION, *STANDARD FOR FIRE DAMPERS.*



2. ADDITIONAL DUCT-SLEEVE CONNECTIONS WERE TESTED BY SMACNA AND WITNESSED BY UL IN 1991. THE CONNECTIONS PERFORMED WITHIN THE REQUIREMENTS OF THE UL TEST CRITERIA. *SEE* NOTE 1, FIGURE 5-2 ON PAGE 5.6.

3. FASTENERS MAY BE USED AS FOLLOWS.

(A) JOINTS USING CONNECTIONS SHOWN IN 1. ABOVE WITH A MAXIMUM OF TWO #10 SHEET METAL SCREWS ON EACH SIDE AND ON THE BOTTOM LOCATED IN THE CENTER OF THE SLIP POCKET AND PENETRATING BOTH SIDES OF THE SLIP POCKET.

FLAT DRIVE SLIP

(B) JOINTS USING CONNECTORS OF THE TYPE SHOWN IN 1. ABOVE ON THE TOP AND THE BOTTOM AND USING FLAT DRIVE SLIPS NOT EXCEEDING 20 in. (510 mm) DUCT HEIGHT ON THE SIDES (*SEE* SKETCH ABOVE).

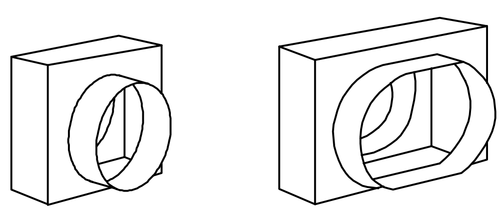
(C) JOINTS WHERE ROUND OR OVAL SPIRAL DUCTS ATTACH TO ROUND OR OVAL COLLARS WHICH ARE PART OF THE DAMPER SLEEVE AS SHOWN BELOW. #10 SHEET METAL SCREWS ARE SPACED EQUALLY AROUND THE CIRCUMFERENCE OF THE DUCT PER THE FOLLOWING:

- DUCT DIAMETERS 22 in. (560 mm) AND SMALLER—3 SCREWS.
- DUCT DIAMETERS OVER 22 in. (560 mm) TO AND INCLUDING 36 in. (915 mm)—5 SCREWS.

NOTES:

(1) FOR FLAT OVAL DUCTS, THE DIAMETER SHALL BE CONSIDERED THE LARGEST (MAJOR) DIMENSION OF THE DUCT.

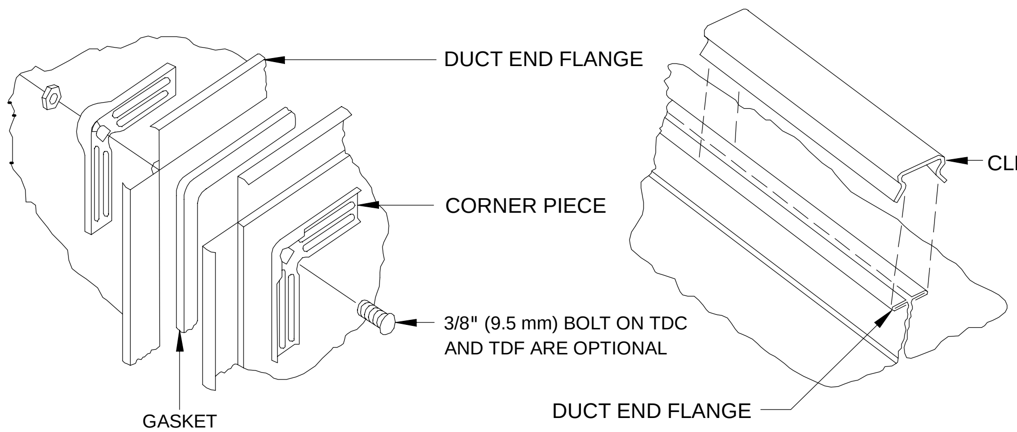
(2) DUCT SEALANT MAY BE USED AS RECOMMENDED BY THE DAMPER MANUFACTURER.



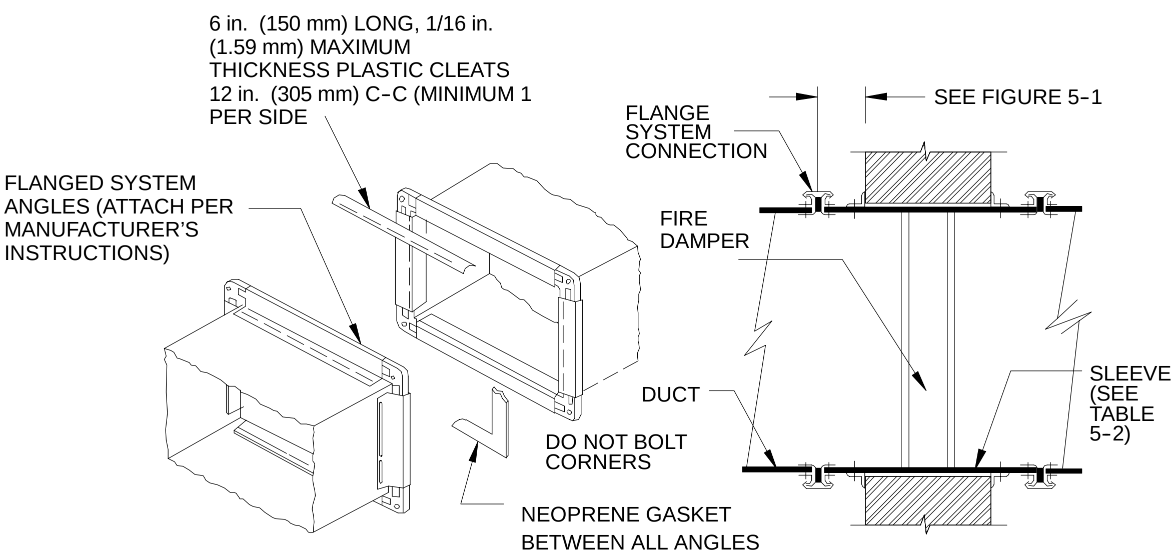
DAMPER/SLEEVE ASSEMBLIES WITH
COLLARS FOR ROUND AND FLAT OVAL DUCTS

FIGURE 5-2 UL DUCT-SLEEVE CONNECTIONS (BREAKAWAY CONNECTIONS)

(D) TDC AND TDF ROLL-FORMED 4-BOLT FLANGED CONNECTIONS ASSEMBLED PER THE MANUFACTURER'S INSTRUCTIONS USING GASKETS, METAL CLEATS AND FOUR 3/8 in. (9.5 mm) METAL NUTS AND BOLTS.



(E) MANUFACTURED SLIP ON 4-BOLT FLANGED CONNECTIONS ASSEMBLED PER THE MANUFACTURER'S INSTRUCTIONS USING GASKETS AND PLASTIC CLEATS AS SHOWN BELOW.



(UL TESTED CONNECTIONS)

NOTE 1: 1991 UL TESTS ARE DESCRIBED IN UL REFERENCE FILE NC 1380 DATED NOVEMBER 11, 1991.

FIGURE 5-2 UL DUCT-SLEEVE CONNECTIONS (BREAKAWAY CONNECTIONS) (Continued)

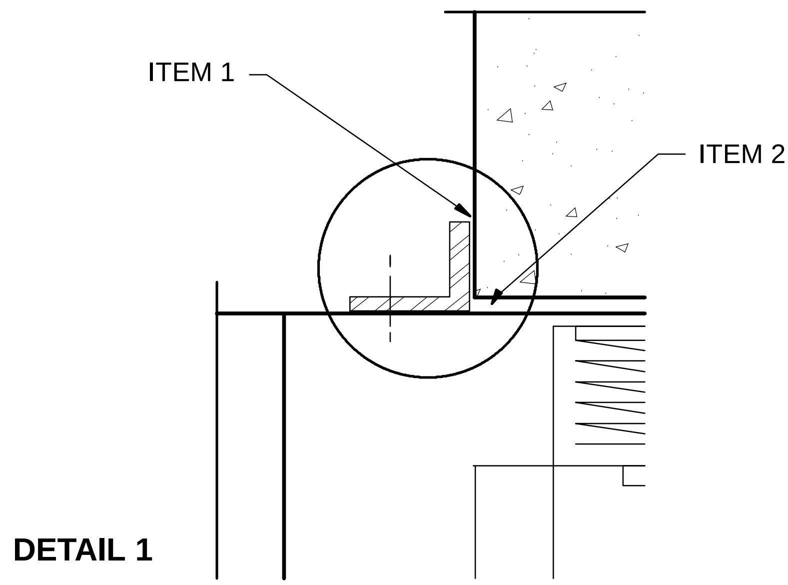


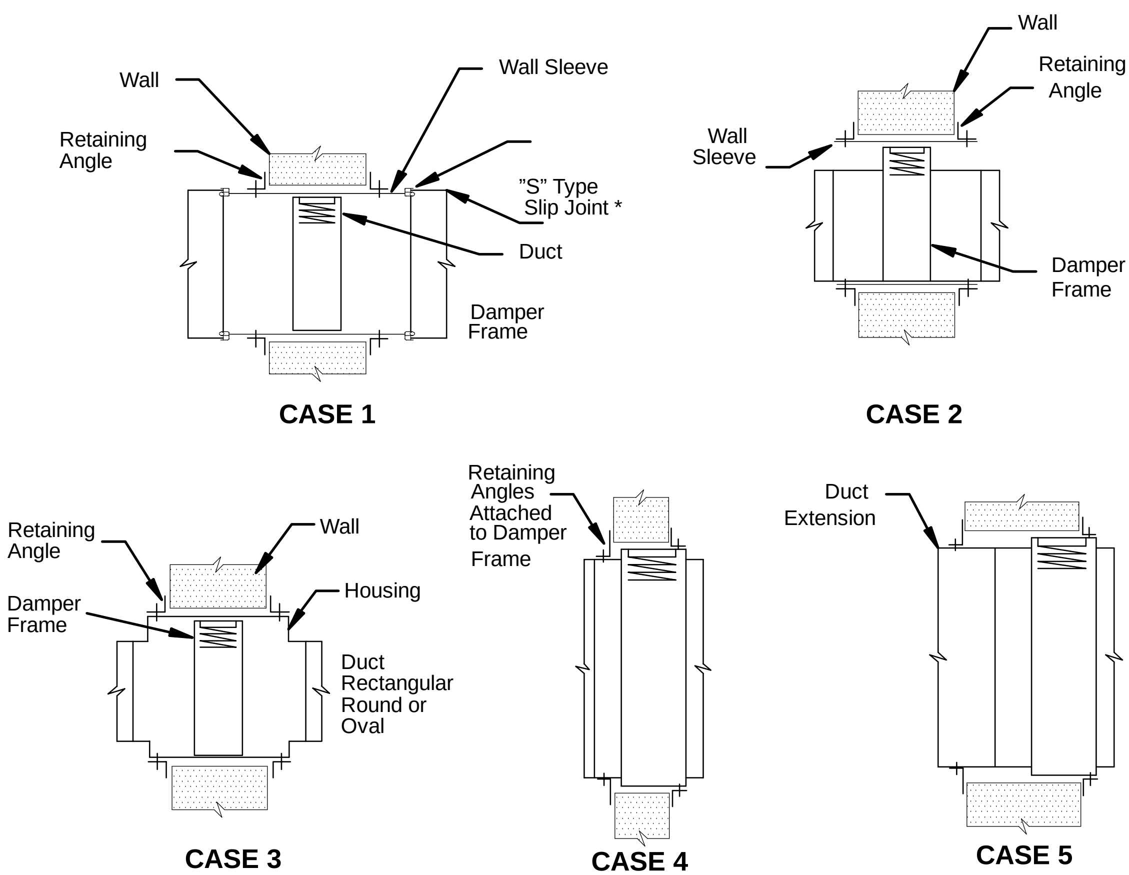
FIGURE 5-3 IMPROPER FIRE DAMPER INSTALLATIONS

ITEM 1

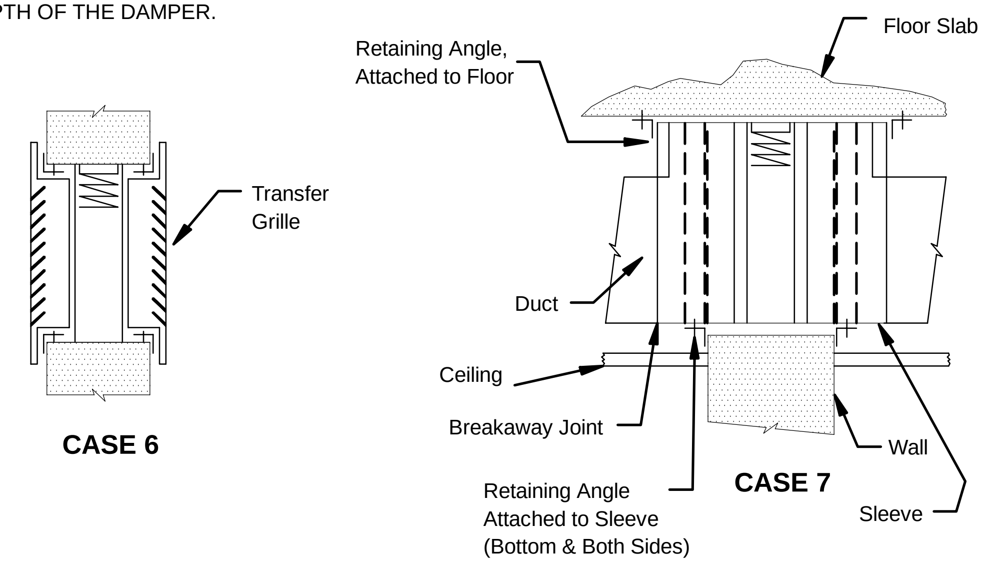
Sealing of the fire damper retaining angles is not a requirement of an approved damper installation. This detail is seldom specified by system designers and is virtually never included in the contractor's pricing for the dampers on a project. If the local authority having jurisdiction mandates that the angles be sealed, contractors should issue a Request For Information (RFI) to design professionals such that the proper approved sealants be used. In no case should the retaining angles be sealed with any product not approved by the damper manufacturer including Through Penetration Firestop products. Using unapproved products could be a violation of the damper manufacturer's conditions of test and listing, could void the UL listing of the damper and could render the damper inoperable.

ITEM 2

Introduction of any materials including mineral wool, ceramic fiber or sealants of any kind into the required expansion space between the damper sleeve and fire partition has not been tested, has not been approved, and is not permitted by damper manufacturers. Doing so could be a violation of the manufacturer's conditions of test and listing, could void the UL listing of the damper and could render the damper inoperable. Indiscriminate and unnecessary deviations from standard fire damper installations should be avoided. Unless a deviation is specifically approved by the damper manufacturer, it could compromise the function for which the damper was ultimately installed.

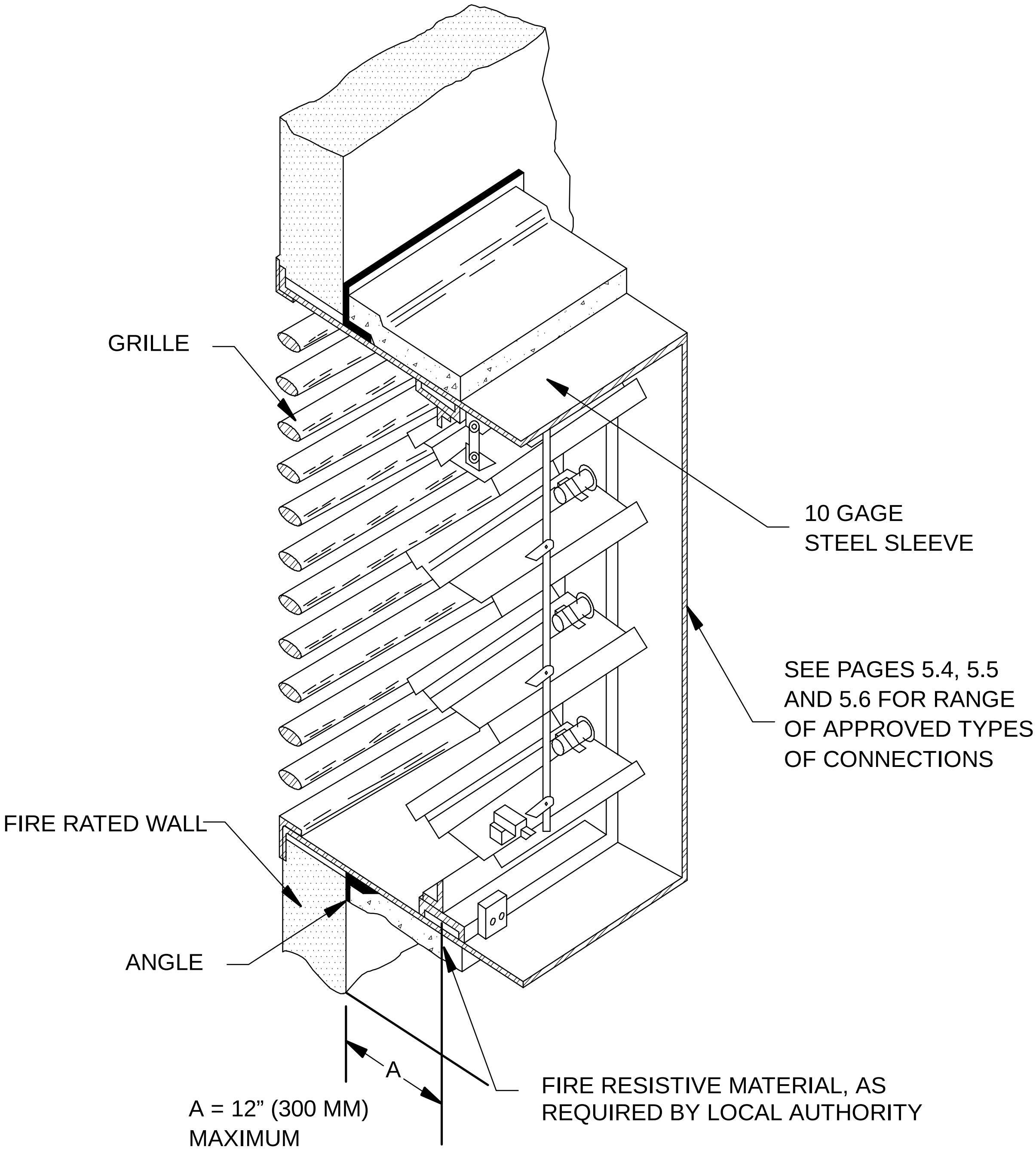


NOTE: IN CASES 4 AND 5, NO SLEEVE IS REQUIRED BUT THE RETAINING ANGLE FASTENERS MUST NOT INTERFERE WITH OPERATION OF DAMPER BLADES. WALL THICKNESS WILL AFFECT THE DEPTH OF THE DAMPER.



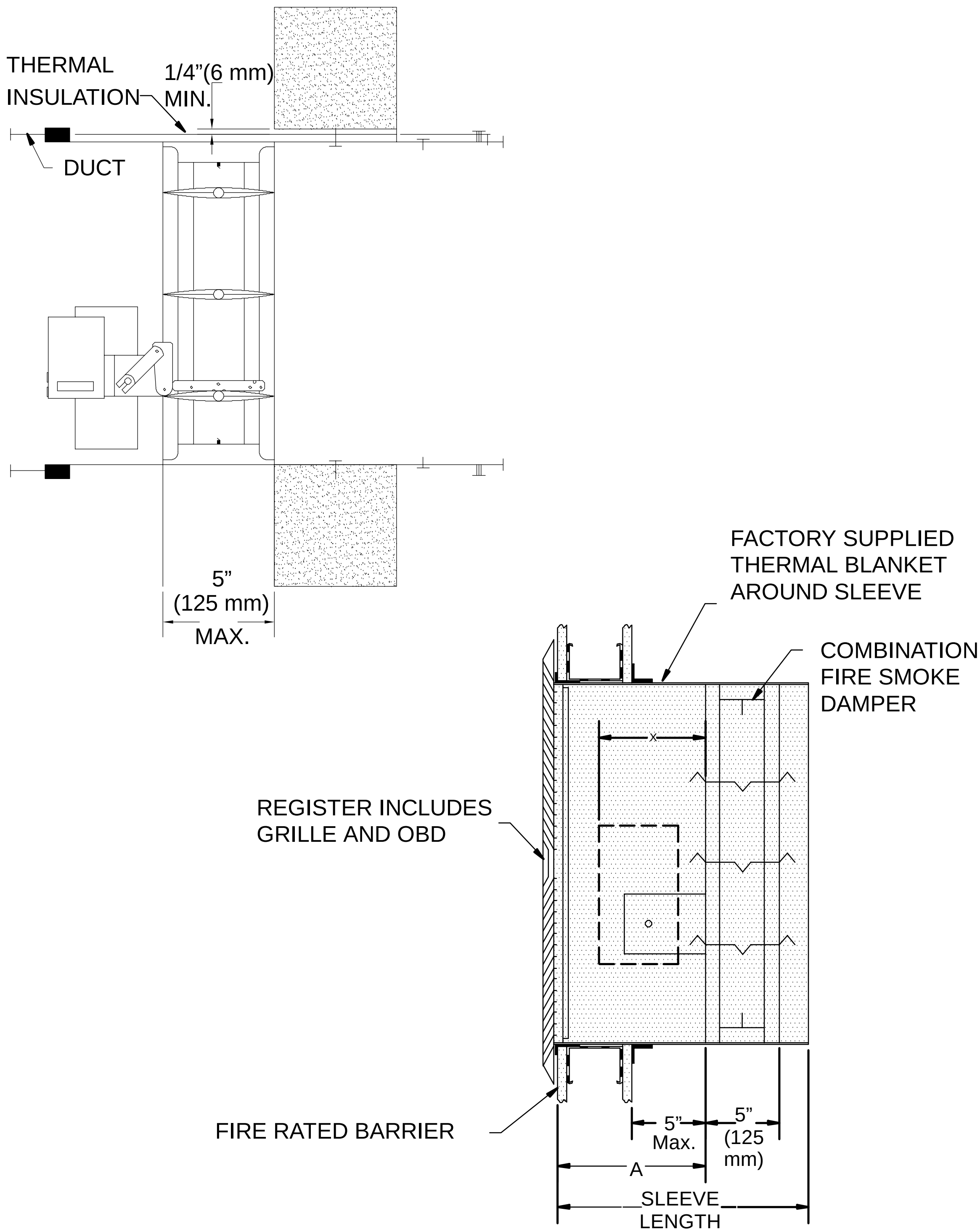
* S Slip is illustrated; see pages 5.5 and 5.6 for range of approved types of connections.

FIGURE 5-4 VERTICAL FIRE DAMPER INSTALLATIONS



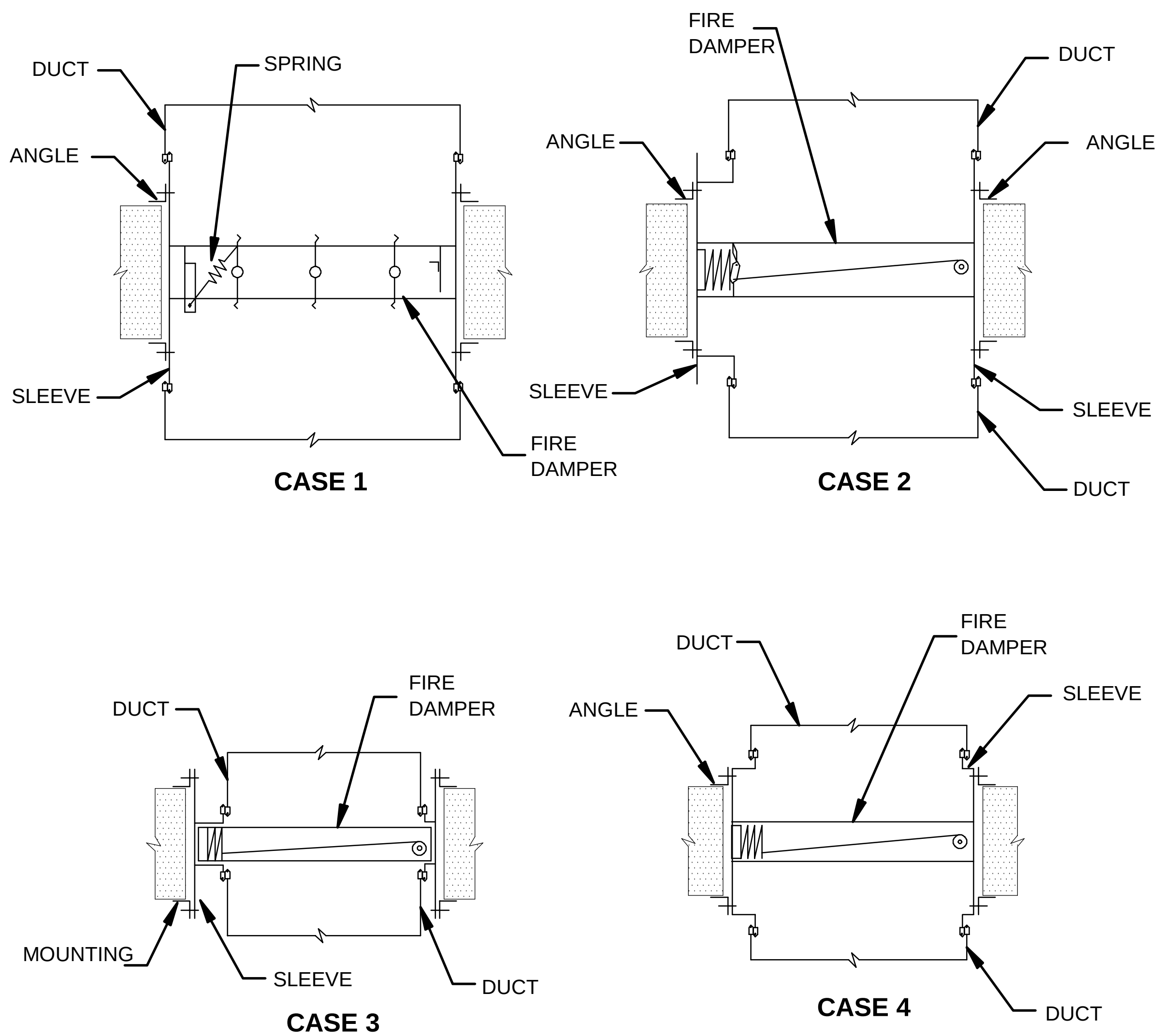
CAUTION: USE THIS ARRANGEMENT ONLY WHEN PHYSICAL OBSTRUCTIONS PRECLUDE USE OF METHODS SUCH AS THOSE IN FIGURE 5-4. THE USE OF THIS METHOD REQUIRES THE APPROVAL OF THE LOCAL AUTHORITY.

FIGURE 5-5 FIRE DAMPER OUT OF WALL



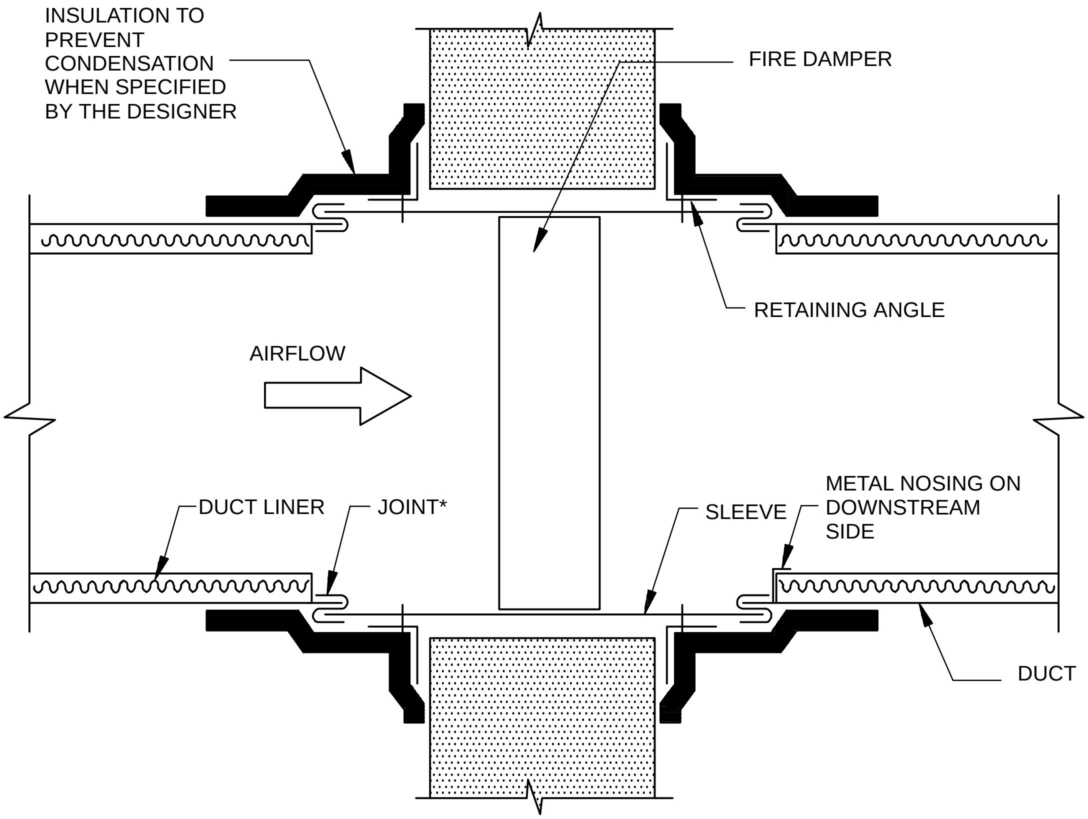
NOTE: SEVERAL DAMPER MANUFACTURERS HAVE AVAILABLE UL TESTED AND LISTED FIRE/COMBINATION FIRE–SMOKE DAMPERS FOR MOUNTING OUT OF THE FIRE BARRIER. CONTACT DAMPER MANUFACTURERS FOR INFORMATION.

FIGURE 5–6 COMBINATION FIRE/SMOKE DAMPER OUT OF WALL INSTALLATION



* S SLIP CONNECTIONS ARE ILLUSTRATED; OTHER TYPES OF BREAKAWAY CONNECTIONS CAN BE USED.

FIGURE 5-7 HORIZONTAL FIRE DAMPER INSTALLATIONS



NOTES:

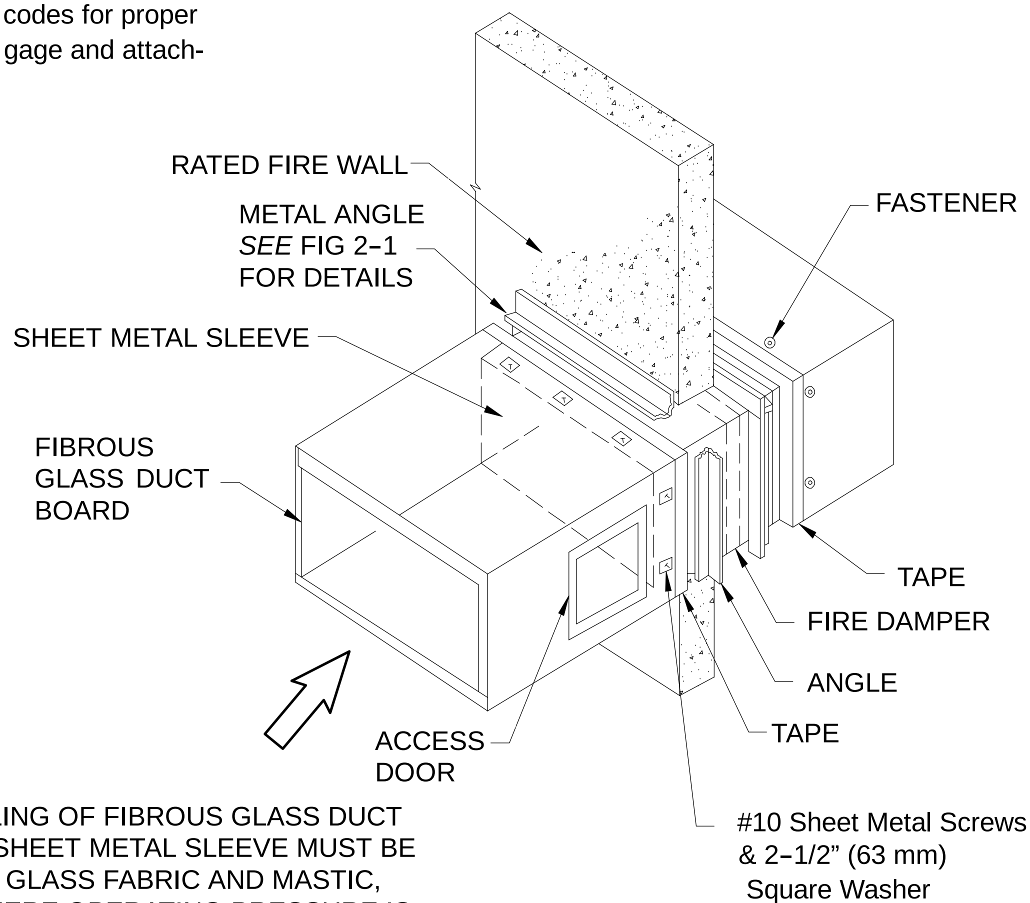
1. INTERRUPTION OF DUCT LINER AT THE FIRE DAMPER IS REQUIRED BY NFPA STANDARD 90A. WHERE 90A IS APPLICABLE, INSTALLATION SHOULD BE MADE AS SHOWN AND SHOULD OTHERWISE CONFORM TO THE SMACNA HVAC DUCT CONSTRUCTION STANDARDS-METAL AND FLEXIBLE.

2. THE DESIGNER SHOULD SPECIFY EXTERNAL INSULATION AS SHOWN TO PREVENT CONDENSATION OCCURRING ON UNLINED METAL AT PENETRATIONS. WHERE THE PROVISIONS OF NFPA 90A ARE APPLICABLE, NEITHER INSULATION NOR LINER CAN EXTEND THROUGH THE WALLS OR FLOORS.

*S SLIP IS ILLUSTRATED; *SEE* FIGURE 5-2 FOR RANGE OF APPROVED TYPES OF CONNECTIONS.

FIGURE 5-8 DUCT LINER INTERRUPTION

FIRE DAMPER INSTALLATION
Sheet metal sleeve must be installed through rated fire wall. Check local codes for proper sheet metal gage and attachment angle.



NOTE: SEALING OF FIBROUS GLASS DUCT BOARD TO SHEET METAL SLEEVE MUST BE MADE WITH GLASS FABRIC AND MASTIC, EXCEPT WHERE OPERATING PRESSURE IS LESS THAN 1” WG. AND SHEET METAL SURFACES ARE CAREFULLY CLEANED, IN WHICH CASE PRESSURE SENSITIVE ALUMINUM FOIL TAPE MAY BE USED.

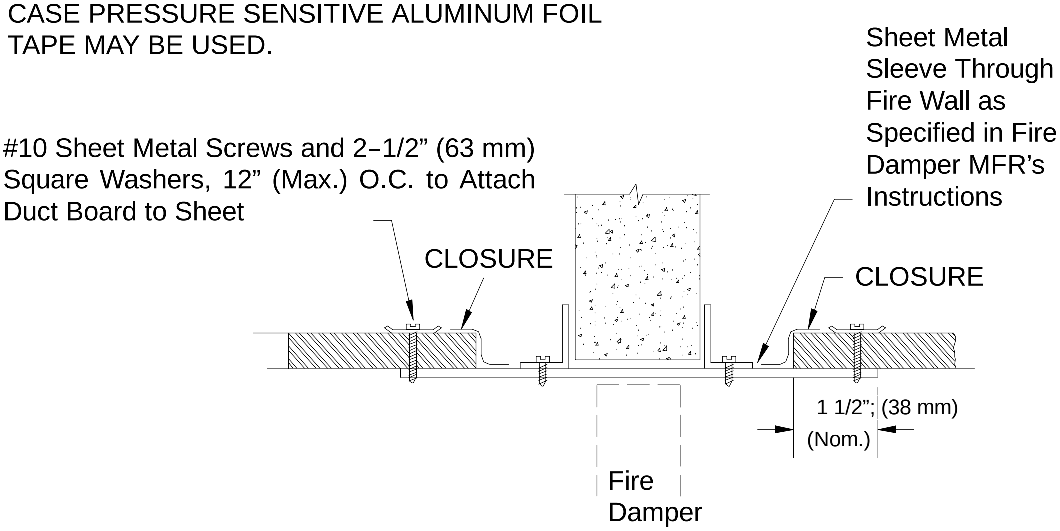


FIGURE 5-9 FIBROUS GLASS DUCT INSTALLATION

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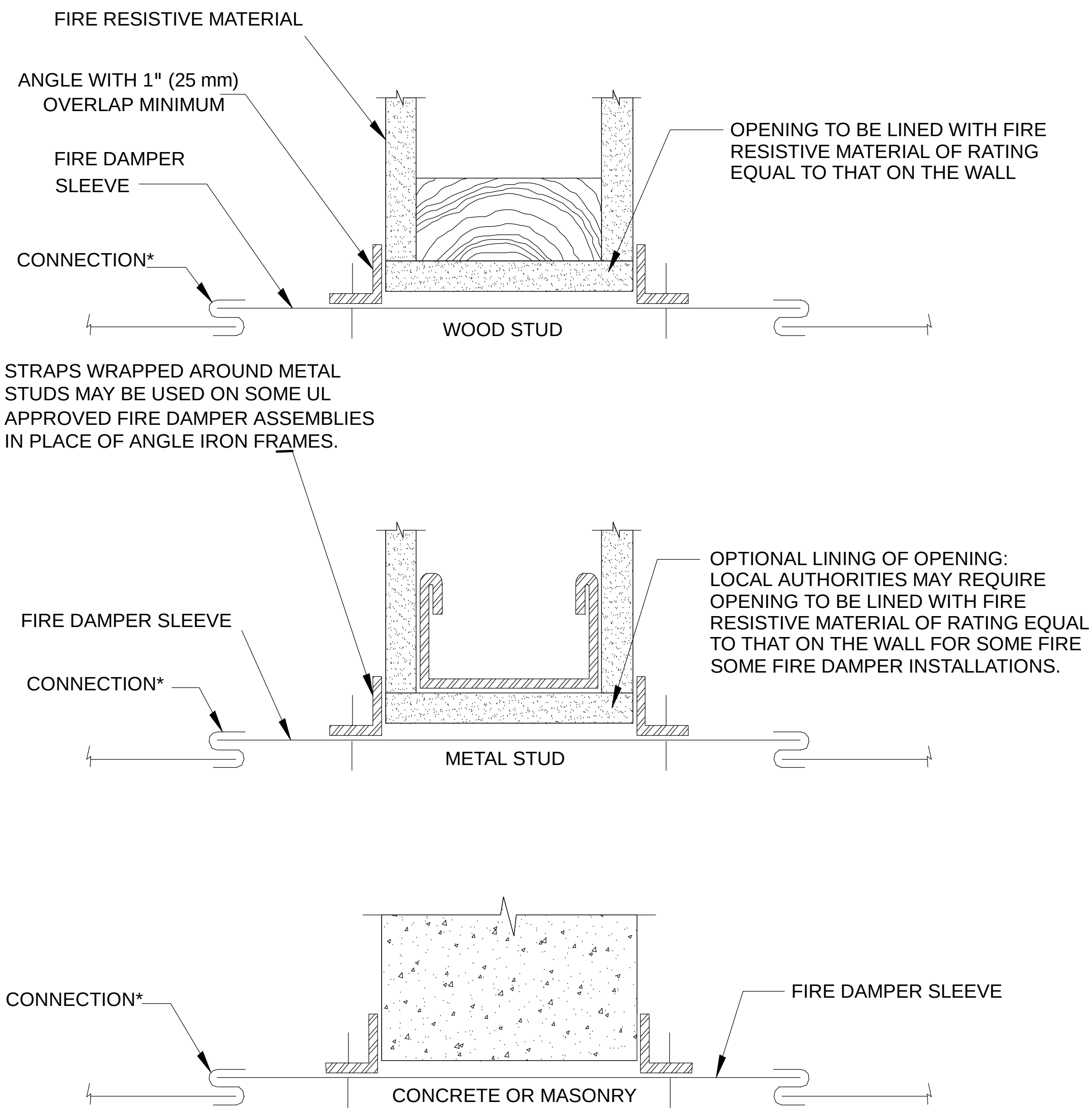
CHAPTER 6

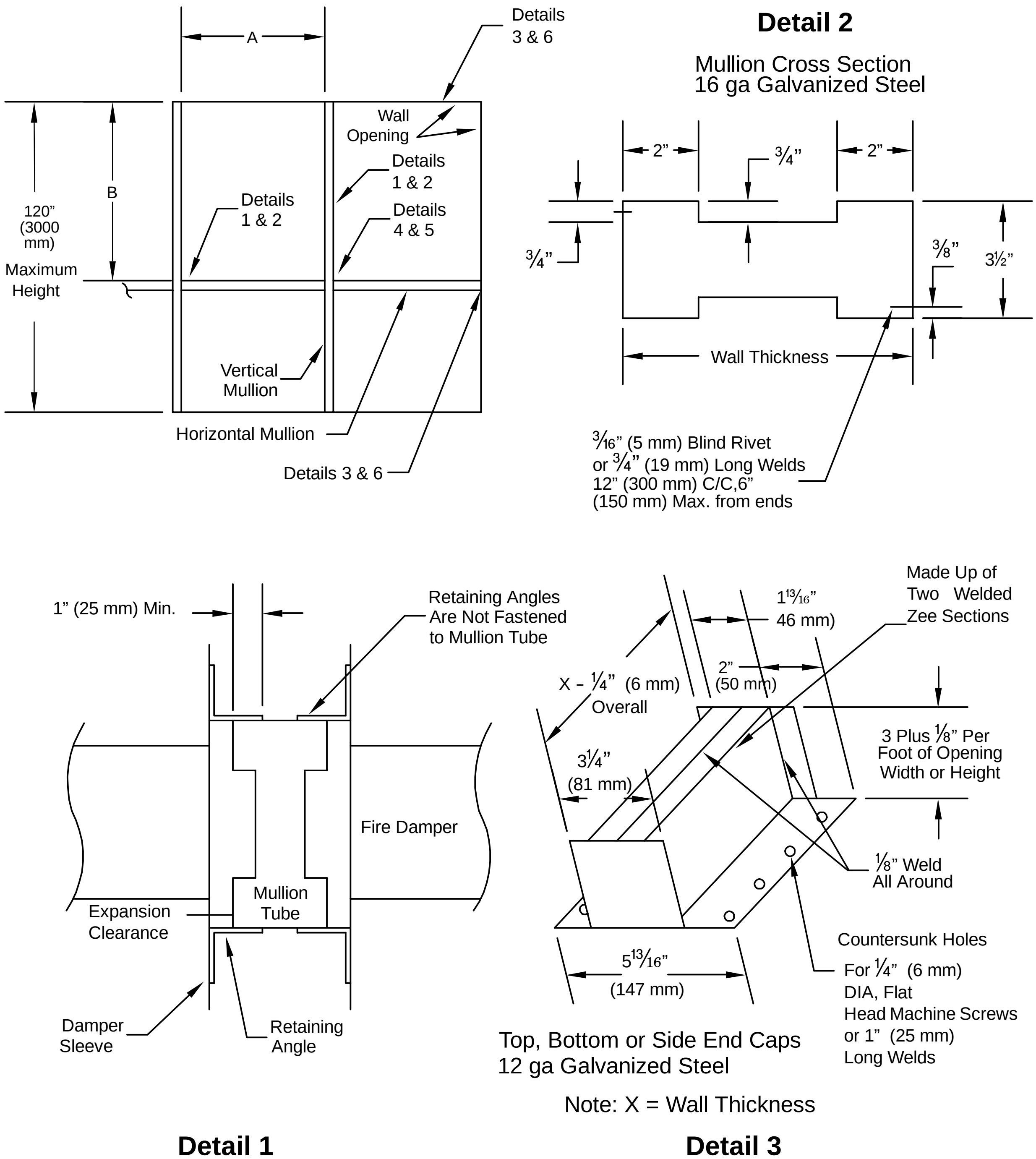
OPENINGS, PENETRATIONS, AND MULLIONS



*S SLIP ILLUSTRATED; SEE FIGURE 5-2 FOR RANGE OF APPROVED TYPES OF CONNECTIONS.

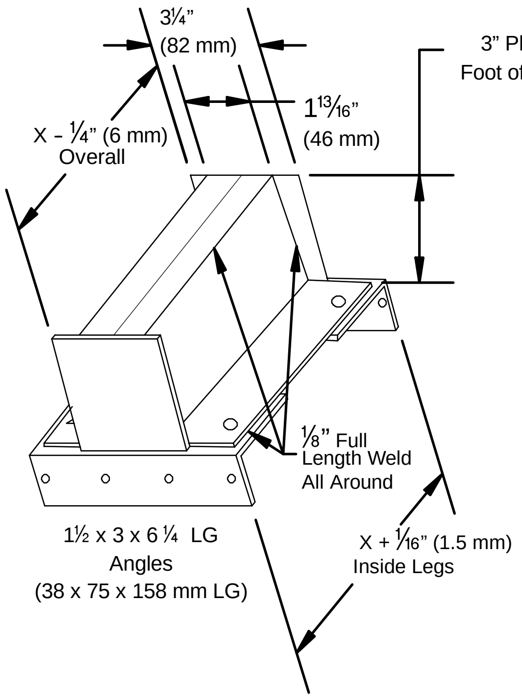
NOTE: THICKNESS AND TYPE OF FIRE RESISTIVE MATERIAL MAY VARY WITH THE JURISDICTION. SPECIFIC FRAMING REQUIREMENTS OF OPENINGS SHOULD BE PROVIDED IN THE ARCHITECTURAL AND STRUCTURAL DRAWINGS THAT ARE SUBMITTED FOR BUILDING PERMITS. ALSO SEE FIRE DAMPER MANUFACTURER'S FRAMING INSTRUCTIONS.

FIGURE 6-1 FIRE DAMPER OPENING PROTECTION



NOTE: CONSULT DAMPER MANUFACTURER'S LITERATURE BEFORE USING.

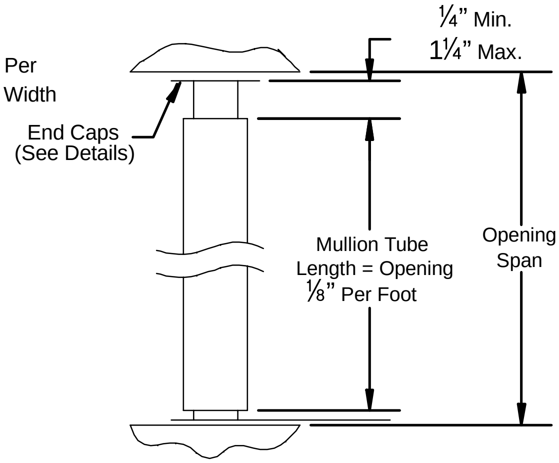
FIGURE 6-2 MULLIONS



Horizontal to Vertical Mullion End Cap
12 ga Galvannized Steel

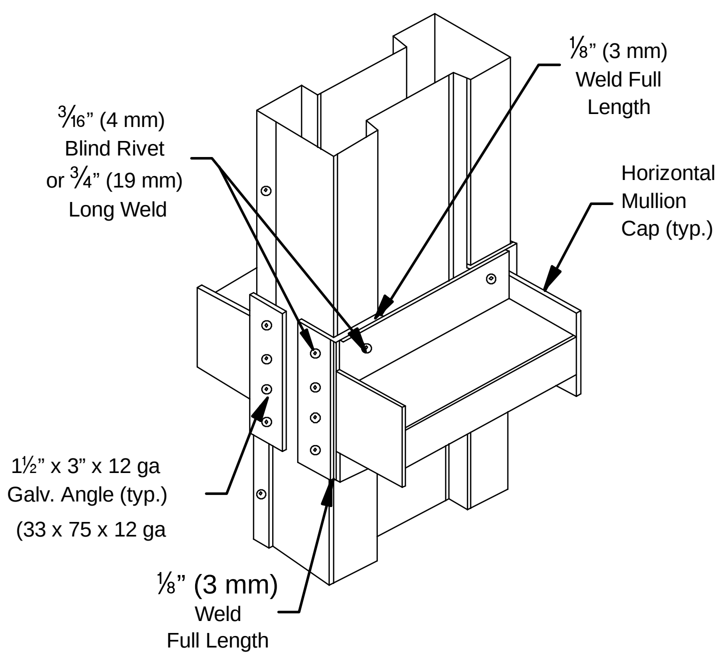
NOTE: X = Wall Thickness

DETAIL 4



The end caps are attached by means of 1" long x ⅜" diameter (25 mm x 9.5 mm) steel expansion anchors embedded into the opening with ¼" (6 mm) diameter flat head machine screws, eight per end cap. If a steel lintel is used, four 1" (25 mm) long welds per end cap (two per leg) may be used.

DETAIL 6



DETAIL 5

NOTES: Referencing Figure 6-2

1. A x B opening sizes are not to exceed the dampers maximum UL 1½ hour multiple galvanized steel fire damper assembly size.

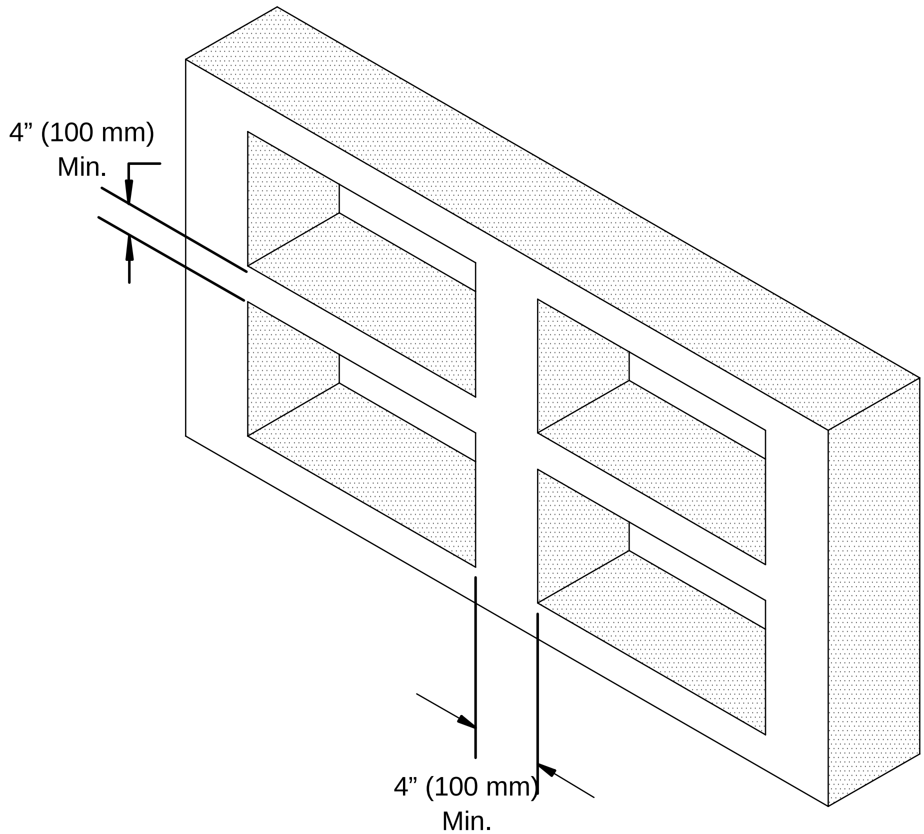
2. Vertical, horizontal or vertical and horizontal mullions can be used, depending on the size of the opening.

3. For ducted systems, each subdivided opening (*e.g.* A x B) must be individually ducted. Steel mullions cannot be in the airstream inside a duct.

4. Mullions are for use in concrete block or poured walls only with a minimum wall thickness of 7" (177 mm) and a maximum wall thickness of 12" (300 mm).

5. Consult the damper manufacturer's literature before using.

FIGURE 6-2 MULLIONS (continued)

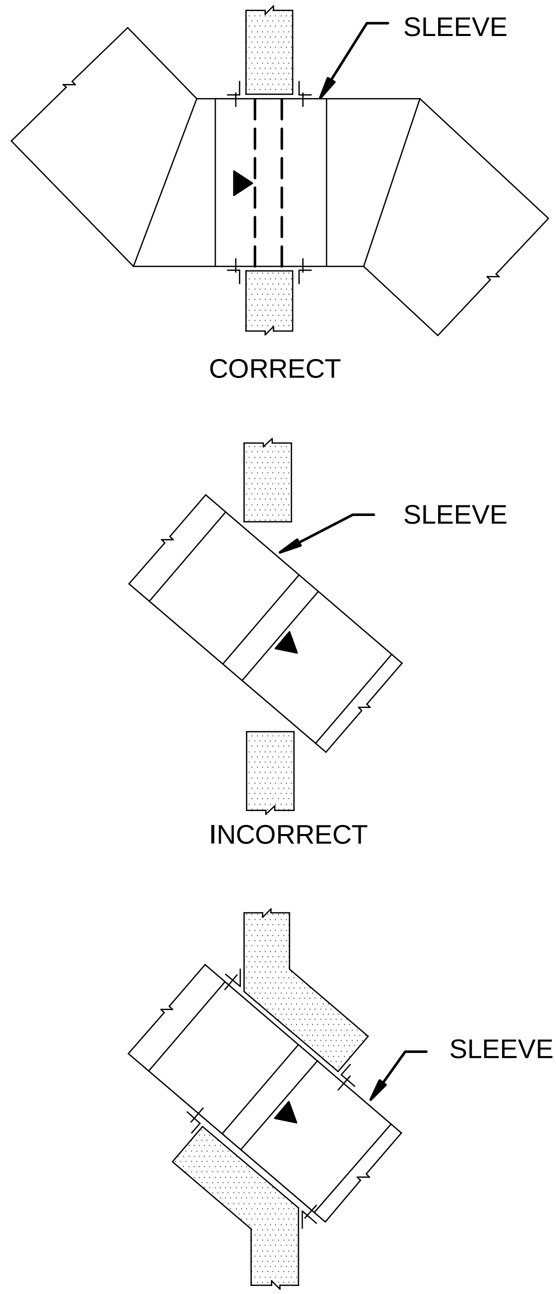


Fire Resistant Barrier with Multiple Openings

NOTE 1: Structural openings shall be sized to permit expansion of the damper assemblies.

NOTE 2: Separate ducts can go to each opening or they can be unducted openings.

FIGURE 6-3 MULTIPLE PENETRATIONS



NOTE: REQUIRED WALL EXTENSIONS / MODIFICATIONS ARE NOT THE RESPONSIBILITY OF THE DUCTWORK CONTRACTOR.

FIGURE 6-4 DIAGONAL PENETRATION (FIRE DAMPERS)

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CHAPTER 7

DAMPER TYPES

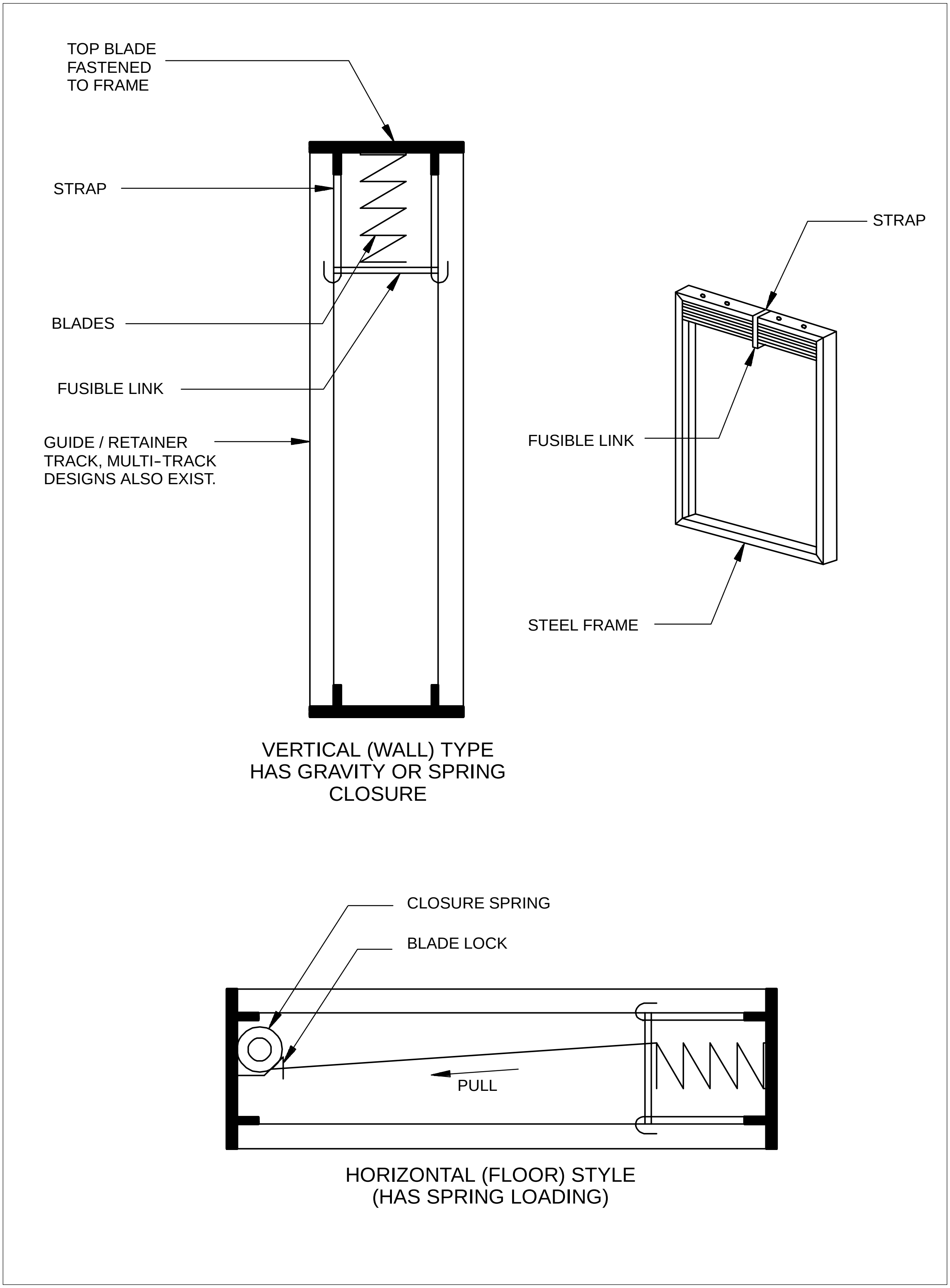


FIGURE 7-1 CURTAIN FIRE DAMPERS

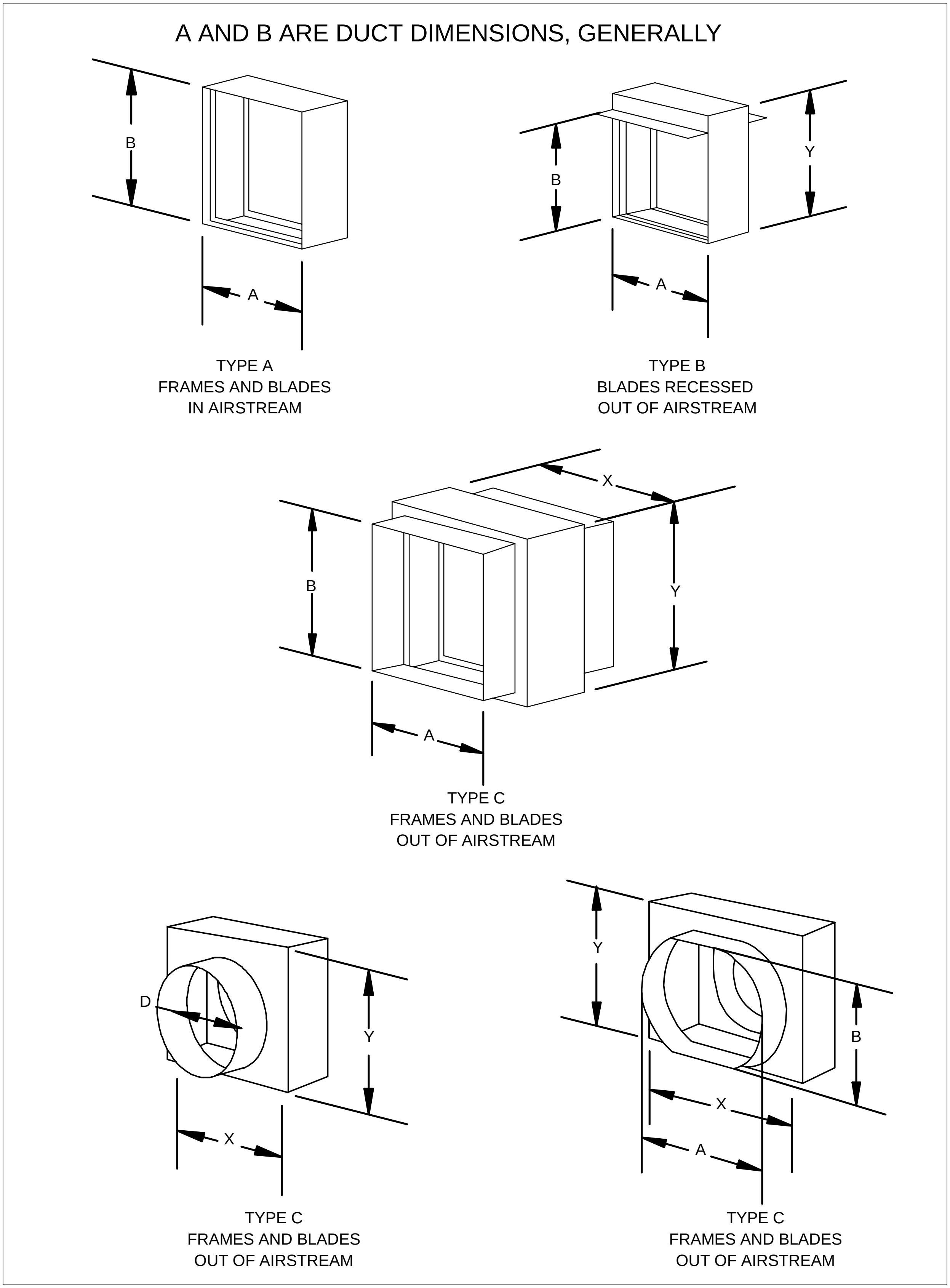
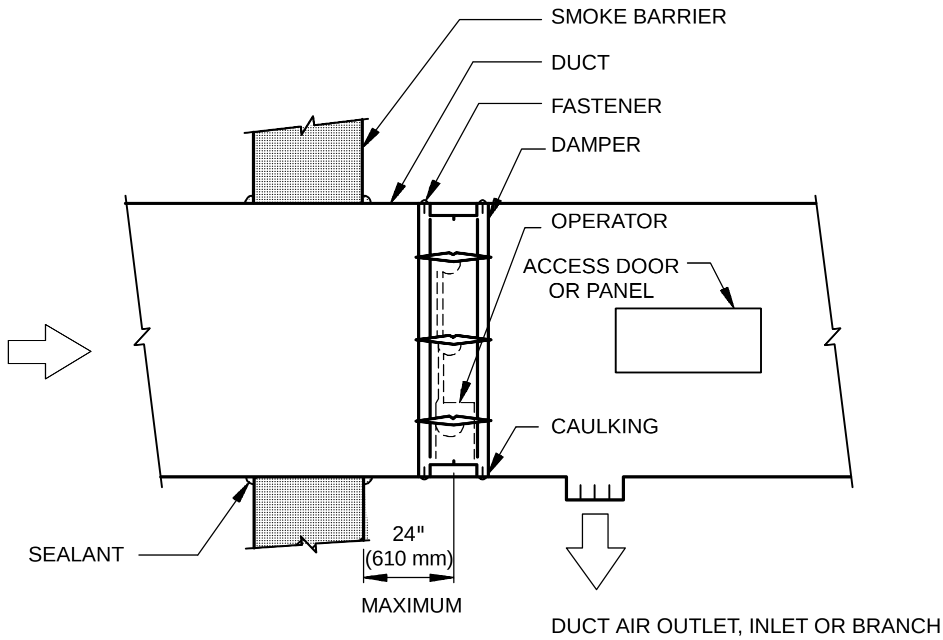


FIGURE 7-2 FIRE DAMPER STYLES



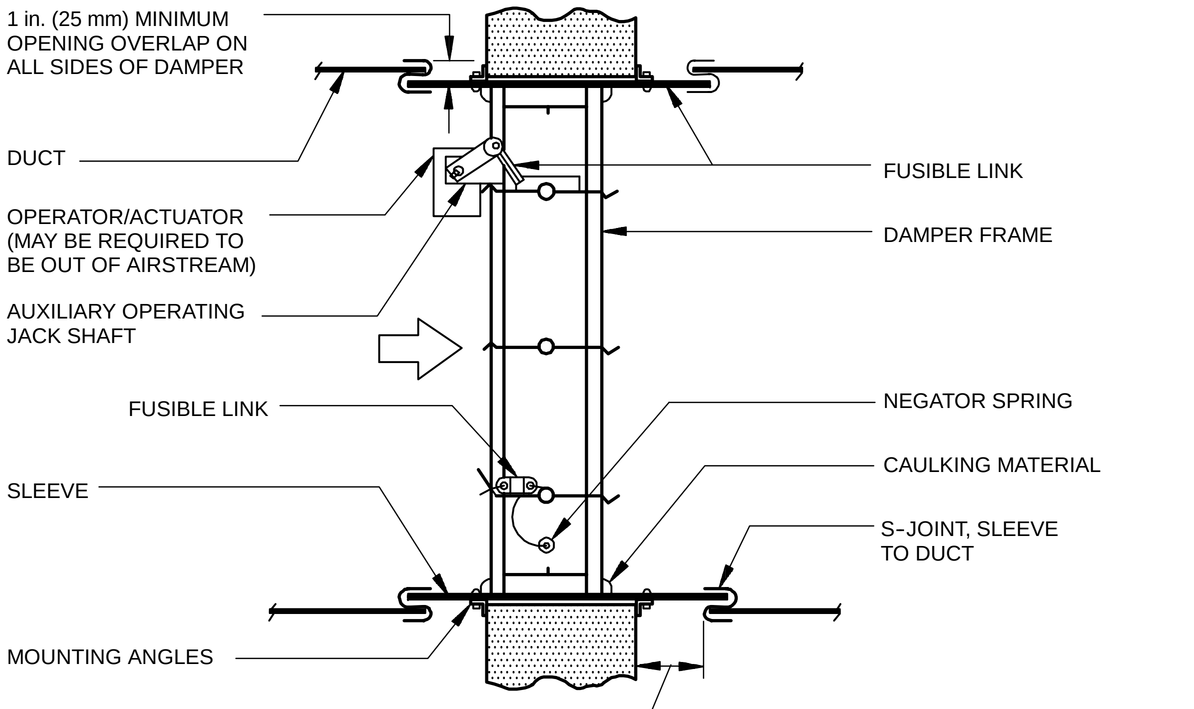
NOTES:

1. SMOKE DAMPERS MUST BE INSTALLED AT OR ADJACENT TO THE POINT WHERE THE DUCT PASSES THROUGH THE SMOKE BARRIER IN ACCORDANCE WITH NFPA 90A. THE MAXIMUM INSTALLATION DISTANCE IS 24 in. (610 mm) FROM THE SMOKE BARRIER, HOWEVER, THE PREFERRED LOCATION OF LEAKAGE RATED SMOKE DAMPERS IS IN THE SMOKE BARRIER. DUCT AIR OUTLETS, INLETS, OR BRANCHES SHALL NOT BE LOCATED BETWEEN THE SMOKE DAMPER AND THE SMOKE BARRIER. SMOKE DAMPERS MUST NOT BE INSTALLED IN FIBROUS GLASS-LINED DUCTS AND FIBROUS GLASS DUCTS IN A MANNER THAT WILL DAMAGE THE MATERIAL. USE A HAT SECTION STANDOFF, LINING INTERRUPTION, METAL SLEEVES, OR SECTIONS OF EXTERNALLY INSULATED METAL DUCT. PROVIDE A DUCT HANGER AT A SMOKE DAMPER LOCATION WHEN THE DUCT STRENGTH IS INADEQUATE FOR THE DAMPER AND ITS OPERATOR. IF THE DAMPER OPERATOR IS LOCATED WITHIN THE DUCT, AN ACCESS DOOR MUST BE PROVIDED.

2. INSTALL PER MANUFACTURER'S INSTALLATION INSTRUCTIONS.

3. SLEEVES / RETAINING ANGLES NOT REQUIRED.

FIGURE 7-3 SMOKE DAMPER



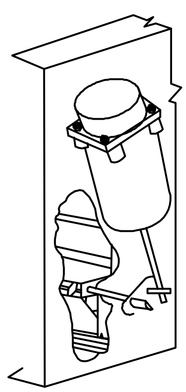
OPERATION:

A. FIRE DAMPER MODE:
HIGH TEMPERATURE MELTS FUSIBLE LINK, CLOSING FIRE DAMPER

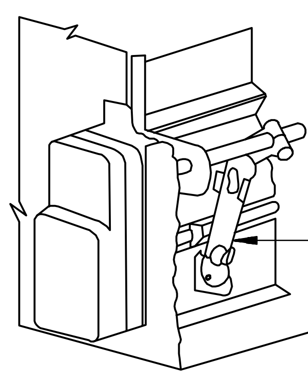
B. SMOKE DAMPER MODE:
SMOKE DETECTOR UPON SENSING HEAT/SMOKE ACTUATES DAMPER MOTOR TO CLOSE DAMPER.

A. SIX INCHES (150 mm) ON ONE SIDE AND SIXTEEN INCHES (405 mm) ON THE OPPOSITE SIDE WITH ACTUATOR.

B. SIXTEEN INCHES (405 mm) ON EACH SIDE FOR DAMPERS INTENDED FOR USE WITH AN ACTUATOR ON ONE SIDE AND A FACTORY INSTALLED ACCESS DOOR ON THE OTHER SIDE.



PNEUMATIC MOTOR OPERATION
FOR BLADE DAMPER



ELECTRIC MOTOR
FOR BLADE DAMPER

THESE ILLUSTRATIONS ARE NOT INTENDED TO EXCLUSIVELY ENDORSE OR INDICATE PREFERENCE FOR A COMBINATION FIRE AND SMOKE DAMPER. TWO SEPARATE DAMPERS THAT SATISFY REQUIREMENTS FOR THE RESPECTIVE FUNCTIONS MAY ALSO BE USED FOR FIRE AND SMOKE CONTROL.

FIGURE 7-4 COMBINATION FIRE AND SMOKE DAMPERS

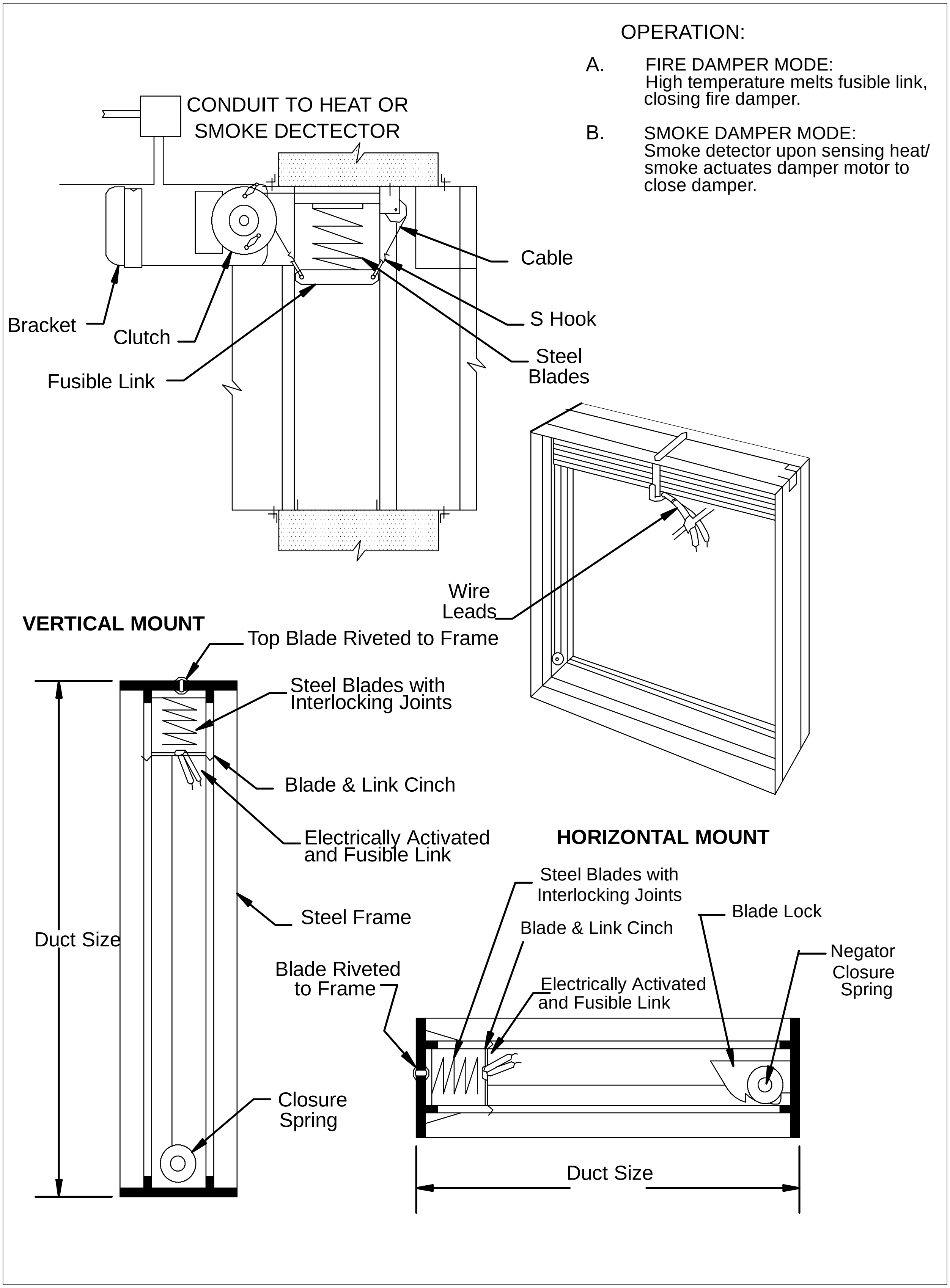


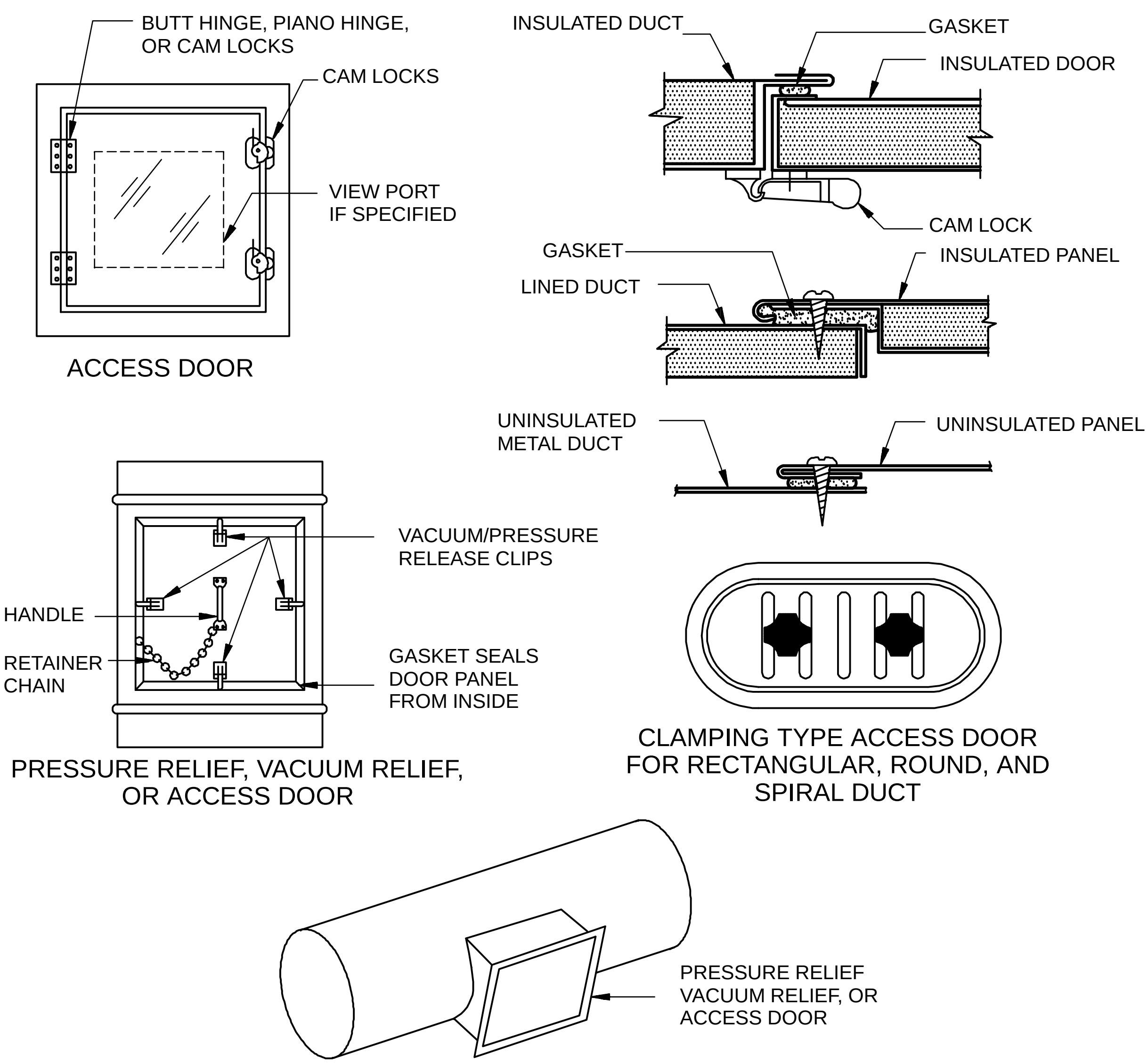
FIGURE 7-5 COMBINATION FIRE AND SMOKE DAMPERS

❑ ❑ ❑ ❑ ❑ ❑ ❑ ❑ ❑ ❑ ❑ ❑	1. Controls a. Pneumatic b. Electric/Electronic 1. Voltage 2. Operator position or configuration c. Position indication switches d. Re-openable or purge operation *Note: UL555S requires that damper operators be factory mounted by the damper manufacturer. Field installation of damper operators is NOT permitted unless specifically approved by the damper manufacturer.* 2. Sleeves a. Length, gage connections — see Table 5-2, Figure 5-2 b. Access doors — see Figure 5-1 3. Leakage Rating a. Class I, II, III

Table 7-1 Combination Fire/Smoke Damper Checklist

CHAPTER 8

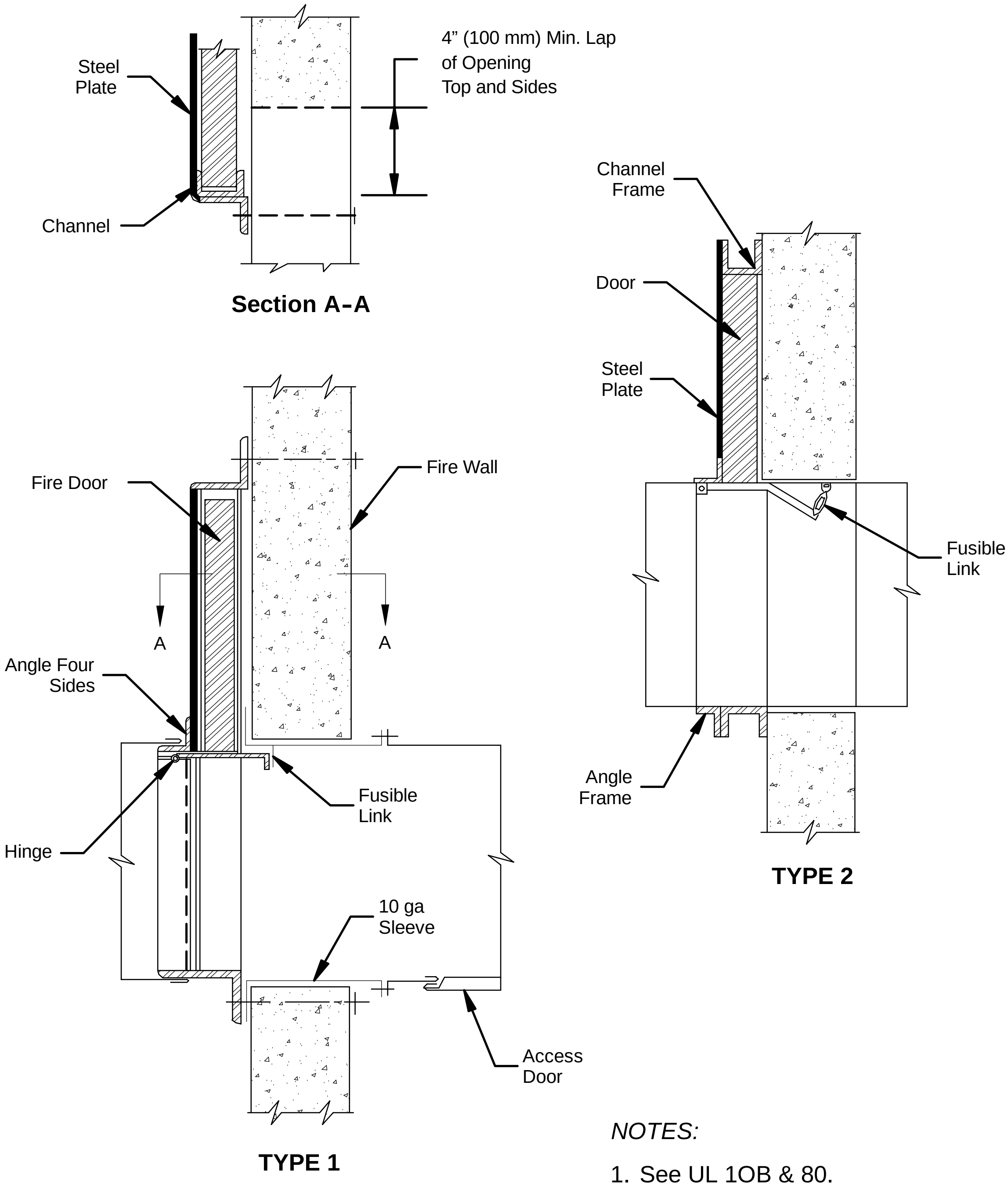
ACCESS DOORS AND FIRE DOORS



NOTES:

1. DOOR TYPE AND INSTALLATION SHALL BE FOR THE PRESSURE CLASSIFICATIONS AND CONSTRUCTION STANDARDS DESIGNATED BY THE SYSTEM DESIGNER TO PREVENT SYSTEM DAMAGE. THE PURPOSE OF A RELIEF DOOR IS TO REDUCE OR ELIMINATE POTENTIAL FOR DUCT COLLAPSE. THESE ILLUSTRATIONS ARE NOT INTENDED TO BE OBLIGATORY.
2. DAMPERS WITH BLADE LOCKS ARE GENERALLY ACCESSIBLE FROM ONE SIDE OF THE DAMPER ONLY. PLACE THE ACCESS DOOR ON THE LATCH RELEASE AND LINK SIDE OF THE FIRE DAMPER.
3. ACCESS DOORS AND PANELS ARE TO BE LARGE ENOUGH TO PERMIT MAINTENANCE AND RESETTING OF DEVICES. DUCT ACCESS DOORS SHALL BE A MAXIMUM OF 24 × 24 in. (610 × 610 mm) AND A MINIMUM OF 6 × 6 in. (150 × 150 mm) UNLESS THE DUCT SIZE DOES NOT ALLOW INSTALLATION OF THE DOOR, IN WHICH CASE, A REMOVABLE SECTION OF DUCT MUST BE USED FOR ACCESS.

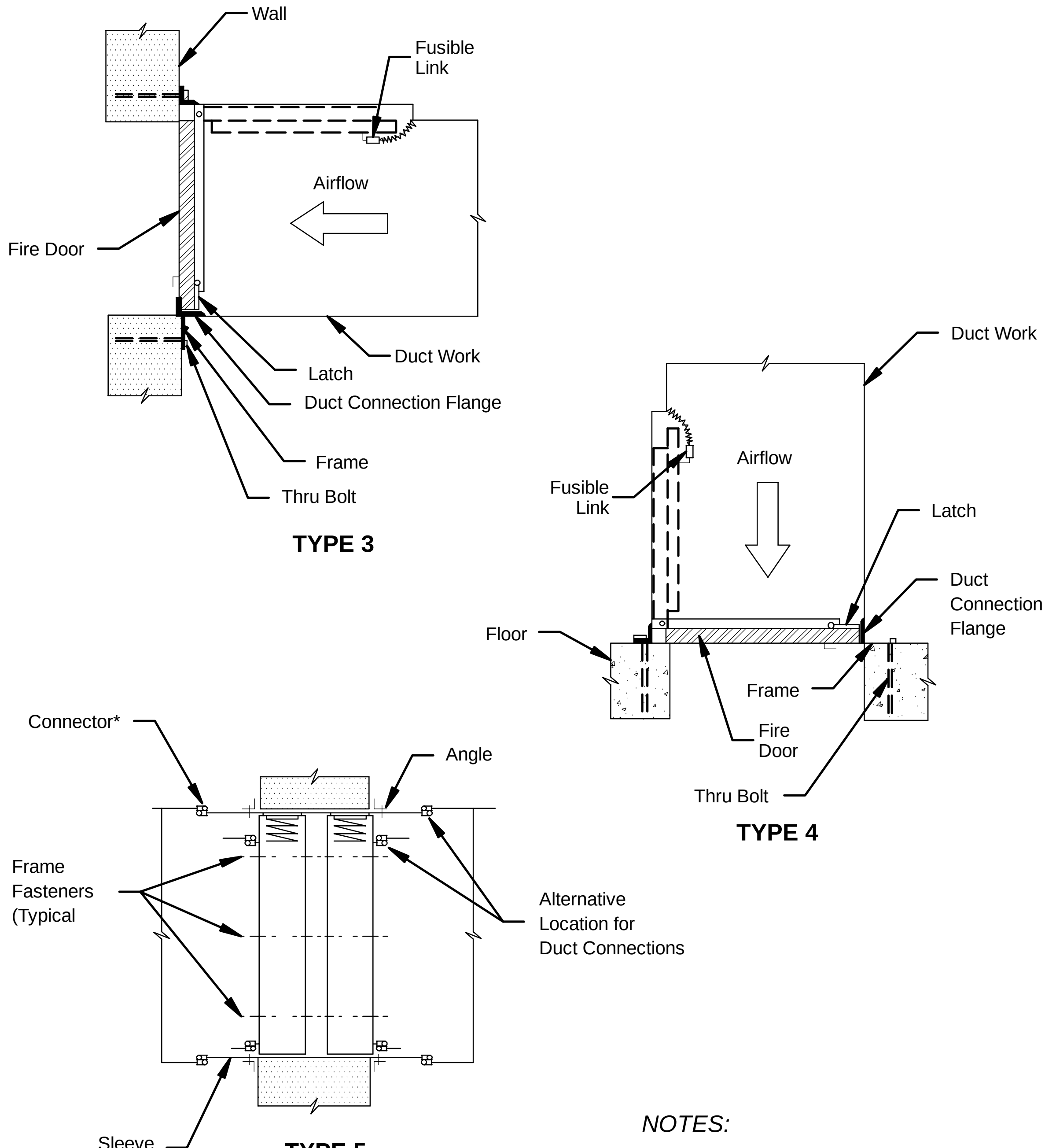
FIGURE 8-1 ACCESS DOORS AND PANELS



NOTES:

1. See UL 1OB & 80.
2. NFPA 90A — 1999 permits 3 - hour rated fire dampers in walls, partitions and floors having fire resistance rating of 3 hours or more.

FIGURE 8-2 FIRE DOOR INSTALLATION



TYPE 5
(3 hour)
(certain styles may use one damper)

NOTES:

1. See UL 1OB & 80.
2. NFPA 90A — 1999 permits 3 – hour rated fire dampers in walls, partitions and floors having fire resistance rating of 3 hours or more.

* S Slip is illustrated; see Table 5–2 and Figure 5–2 for range of approved types of connections.

FIGURE 8–2 FIRE DOOR INSTALLATION (continued)

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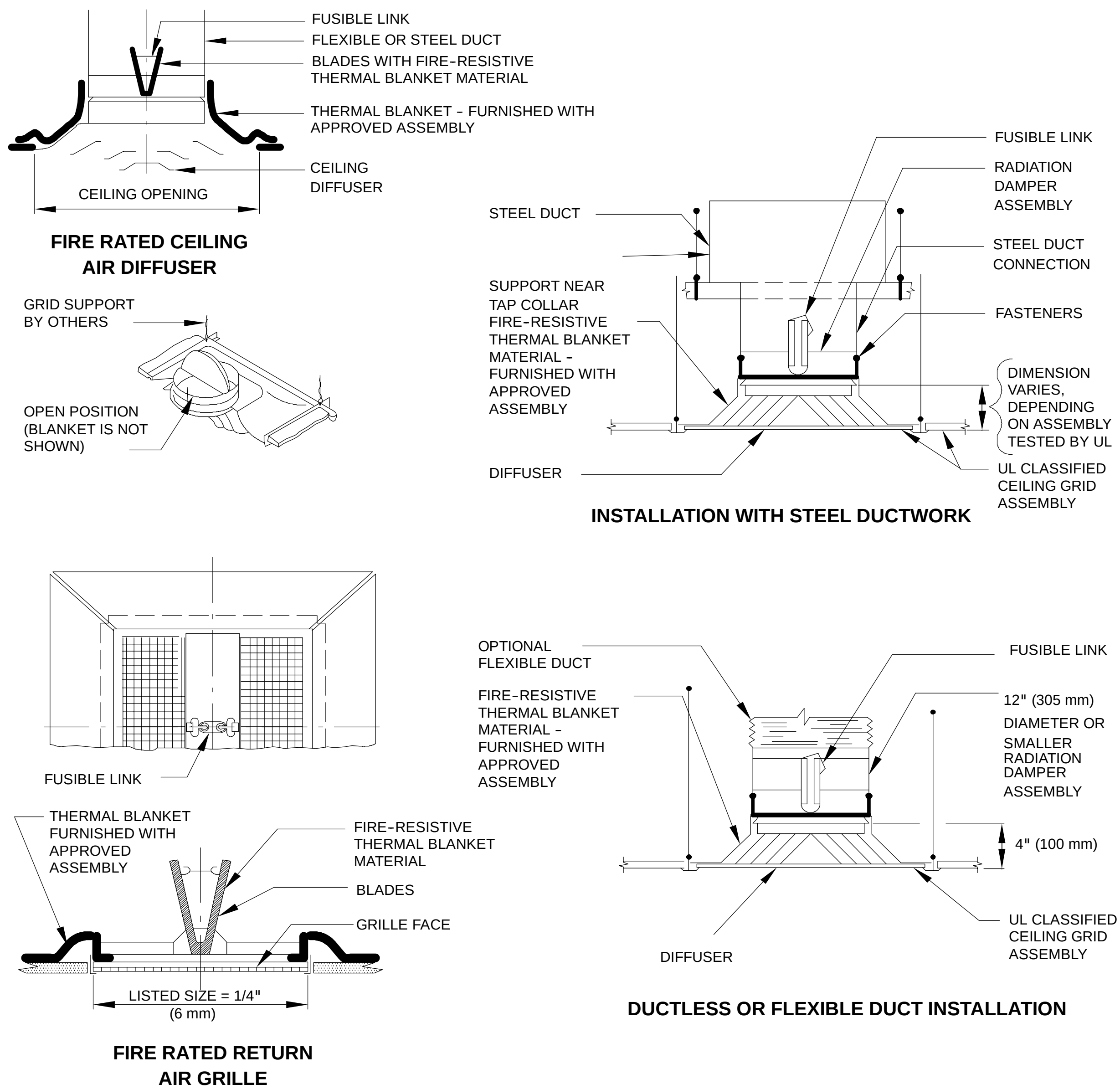
CHAPTER 9

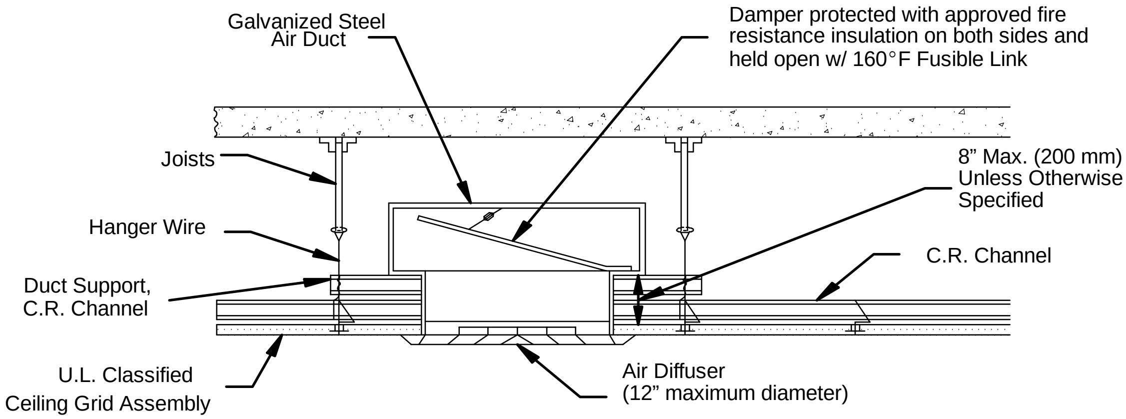
CEILING ASSEMBLIES, RADIATION DAMPERS AND HEAT STOPS



NOTES:

1. SEE THE UL "FIRE RESISTANCE DIRECTORY" FOR USE WITH FIRE RATED CEILING/FLOOR OR CEILING/ROOF ASSEMBLIES.
2. OTHER STYLES, SIZES AND TYPES OF UL DESIGNATED CEILING DAMPERS EXIST. THESE ARE SHOWN AS SAMPLES ONLY. RATINGS ARE PER UL 555C, CEILING DAMPERS.
3. A MAXIMUM SIZE CEILING PENETRATION OF 576 SQUARE INCHES CAN BE PROTECTED USING THE THERMAL INSULATION BLANKET. THE THERMAL INSULATION BLANKET PROTECTS THE EXPOSED PORTION OF THE CEILING DIFFUSER AND THE CEILING DAMPER PROTECTS THE NECK OR INLET OF THE CEILING DIFFUSER.
4. SOME INSTALLATIONS REQUIRE A MINIMUM ½" (12 mm) LAP OF THE DIFFUSER FLANGE OVER THE CEILING TILE.
5. DAMPER ASSEMBLIES MAY REQUIRE SEPARATE SUPPORTS.
6. DIFFUSER BACKPAN MUST BE STEEL.

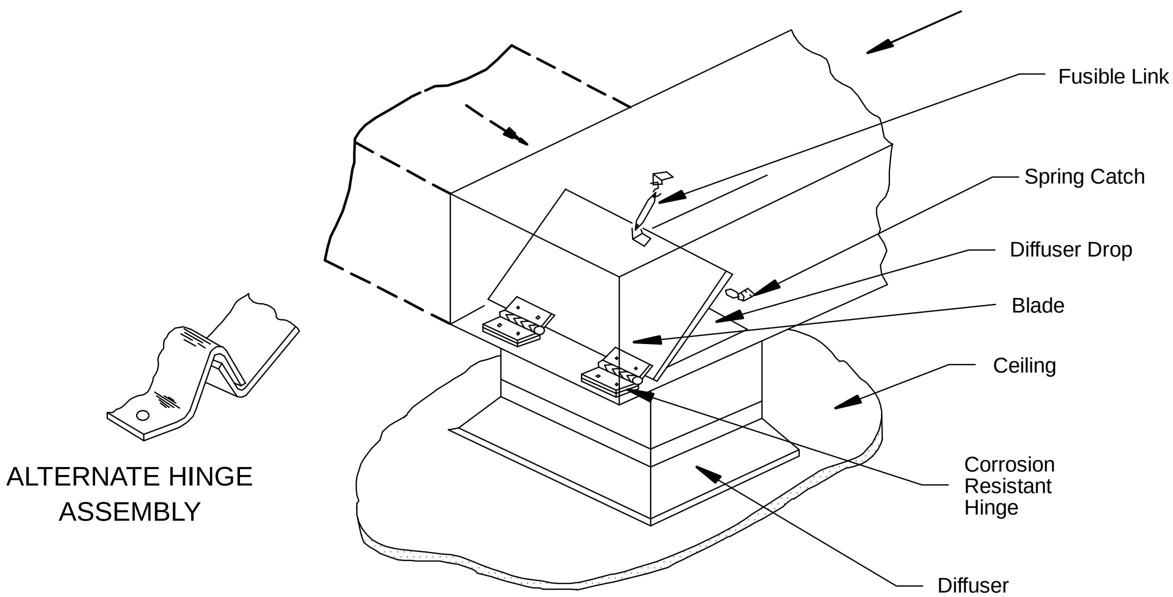
FIGURE 9-1 FIRE RATED CEILING ASSEMBLIES



Hinged Sheet Steel Damper

Diffuser flange laps tile

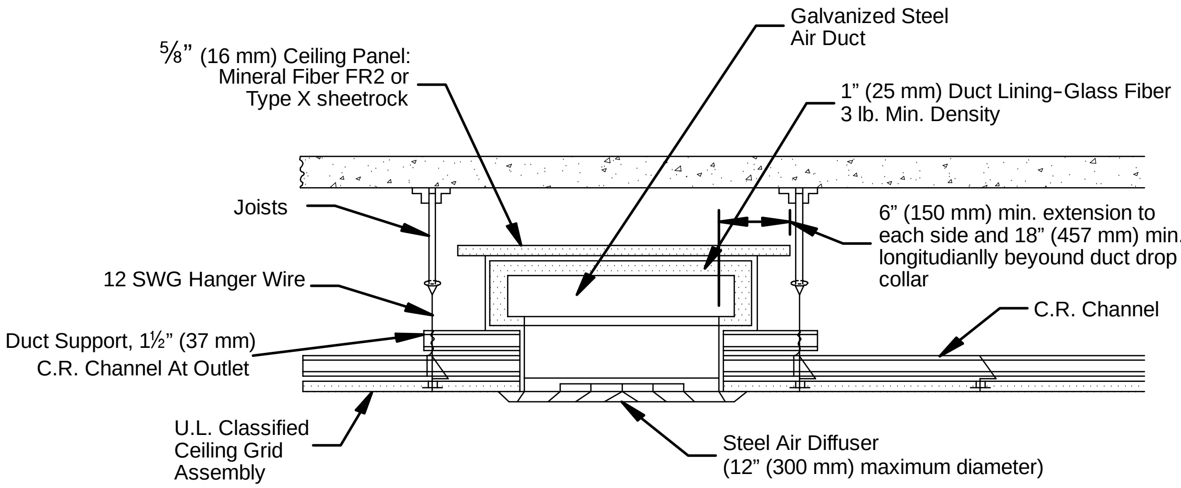
(Label not required, however, the UL Fire Resistance Directory stringently controls duct gage, hanger type, hanger location and hanger spacing.)



NOTES:

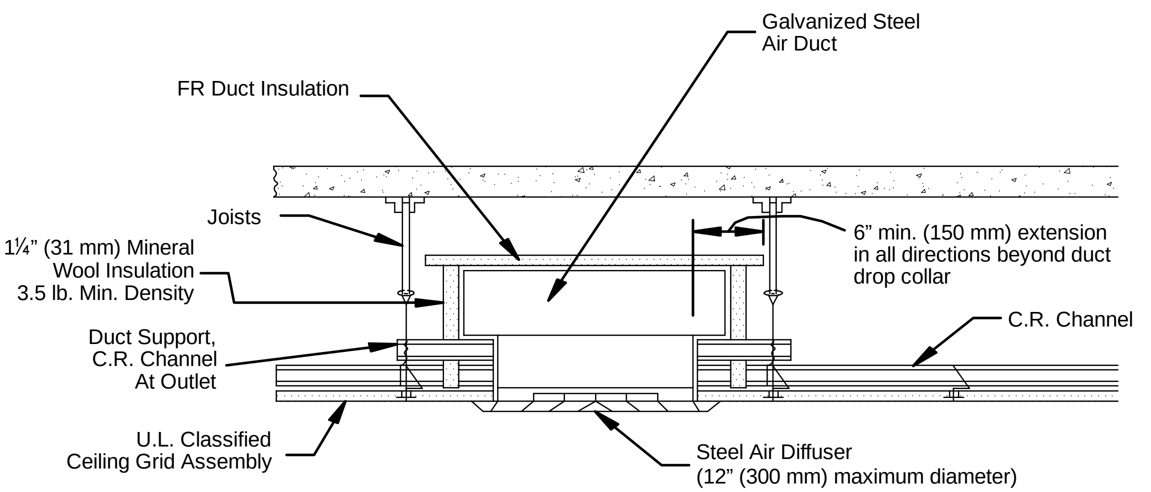
1. Lay-in diffusers may also require protection board on top of the duct as in Figure 9-4. See UL design G-252 or P210 for example.
2. Needs access door to reach fusible link and spring catch.

FIGURE 9-2 RADIATION DAMPER - HINGED



Note: Local Codes often contain additional requirements.

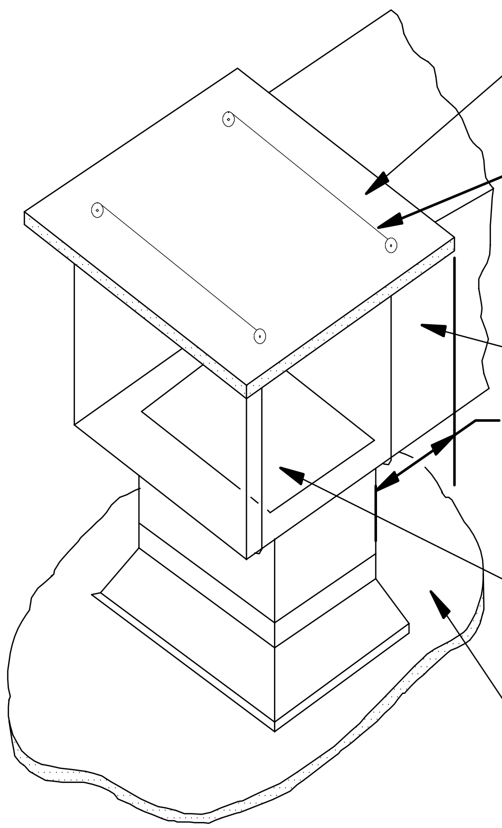
Protection System A (UL)



Protection System B (UL)

Use of System A or B is Contingently Defined in the UL Fire Resistance Directory.

FIGURE 9-3 CEILING HEAT STOP - UL SYSTEMS A& B



U.L. designs A210, G028, G218, G244, etc.

(12 inch diffuser-maximum size)

See U.L. Fire Resistance Directory

For slotted diffusers and exhausts see stipulations for U.L. designs D216, G036, G203, L005

FIGURE 9-4 CEILING HEAT STOP - PROTECTION BOARD

CHAPTER 10

SYMBOLS

SYMBOL MEANING	SYMBOL
POINT OF CHANGE IN DUCT CONSTRUCTION (BY STATIC PRESSURE CLASS)	
DUCT (1ST FIGURE, SIDE SHOWN 2ND FIGURE, SIDE NOT SHOWN)	20 x 12
ACOUSTICAL LINING DUCT DIMENSIONS FOR NET FREE AREA	
DIRECTION OF FLOW	
DUCT SECTION (SUPPLY)	S 30 x 12
DUCT SECTION (EXHAUST OR RETURN)	E OR R 20 x 12
INCLINED RISE (R) OR DROP (D) ARROW IN DIRECTION OF AIR FLOW	R
TRANSITIONS: GIVE SIZES. NOTE F.O.T. FLAT ON TOP OR F.O.B. FLAT ON BOTTOM IF APPLICABLE	
STANDARD BRANCH FOR SUPPLY & RETURN (NO SPLITTER)	S R
WYE JUNCTION	
VOLUME DAMPER MANUAL OPERATION	VD
AUTOMATIC DAMPERS MOTOR OPERATED	SEC MOD
ACCESS DOOR (AD) ACCESS PANEL (AP)	OR AD
FIRE DAMPER: SHOW ◀ VERTICAL POS. SHOW ◆ HORIZ. POS.	FD AD
SMOKE DAMPER S	AD S
FIRE & SMOKE DAMPER – SMOKE DAMPER – S RADIATION DAMPER – R	
TURNING VANES	
FLEXIBLE DUCT FLEXIBLE CONNECTION	
GOOSENECK HOOD (COWL)	
BACK DRAFT DAMPER	BDD

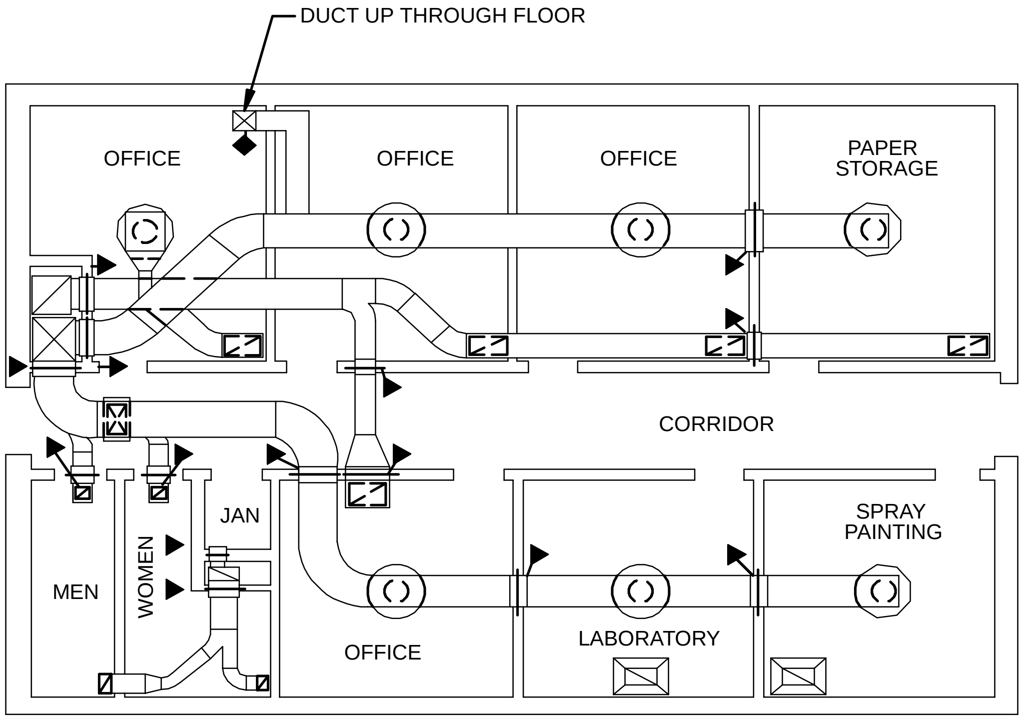
SYMBOL MEANING	SYMBOL
SUPPLY GRILLE (SG)	20 x 12 SG 700 CFM
RETURN (RG) OR EXHAUST (EG) GRILLE (NOTE AT FLR OR CLG)	20 x 12 RG 700 CFM
SUPPLY REGISTER (SR) (A GRILLE + INTEGRAL VOL. CONTROL)	20 x 12 SR 700 CFM
EXHAUST OR RETURN AIR INLET CEILING (INDICATE TYPE)	20 x 12 GR 700 CFM
SUPPLY OUTLET. CEILING, ROUND (TYPE AS SPECIFIED) INDICATE FLOW DIRECTION	20 700 CFM
SUPPLY OUTLET. CEILING, SQUARE (TYPE AS SPECIFIED) INDICATE FLOW DIRECTION	12 x 12 700 CFM
TERMINAL UNIT. (GIVE TYPE AND OR SCHEDULE)	T.U.
COMBINATION DIFFUSER AND LIGHT FIXTURE	
DOOR GRILLE	DG 12 x 6
SOUND TRAP	ST
FAN & MOTOR WITH BELT GUARD & FLEXIBLE CONNECTIONS	
VENTILATING UNIT (TYPE AS SPECIFIED)	
UNIT HEATER (DOWNBLAST)	
UNIT HEATER (HORIZONTAL)	
UNIT HEATER (CENTRIFUGAL FAN) PLAN	
THERMOSTAT	T
POWER OR GRAVITY ROOF VENTILATOR – EXHAUST (ERV)	
POWER OR GRAVITY ROOF VENTILATOR – INTAKE (SRV)	
POWER OR GRAVITY ROOF VENTILATOR – LOUVERED	
LOUVERS & SCREEN	36 H x 24 L

FIGURE 10-1 SYMBOLS FOR HVAC SYSTEMS (I-P)

SYMBOL MEANING	SYMBOL
POINT OF CHANGE IN DUCT CONSTRUCTION (BY STATIC PRESSURE CLASS)	
DUCT (1ST FIGURE, SIDE SHOWN 2ND FIGURE, SIDE NOT SHOWN)	508 x 305
ACOUSTICAL LINING DUCT DIMENSIONS FOR NET FREE AREA	
DIRECTION OF FLOW	
DUCT SECTION (SUPPLY)	S 762 x 305
DUCT SECTION (EXHAUST OR RETURN)	E OR R 762 x 305
INCLINED RISE (R) OR DROP (D) ARROW IN DIRECTION OF AIR FLOW	R
TRANSITIONS: GIVE SIZES. NOTE F.O.T. FLAT ON TOP OR F.O.B. FLAT ON BOTTOM IF APPLICABLE	
STANDARD BRANCH FOR SUPPLY & RETURN (NO SPLITTER)	S R
WYE JUNCTION	
VOLUME DAMPER MANUAL OPERATION	VD
AUTOMATIC DAMPERS MOTOR OPERATED	SEC MOD
ACCESS DOOR (AD) ACCESS PANEL (AP)	OR AD
FIRE DAMPER: SHOW ◀ VERTICAL POS. SHOW ◆ HORIZ. POS.	FD AD
SMOKE DAMPER S	AD S
FIRE & SMOKE DAMPER – ▲ SMOKE DAMPER – S RADIATION DAMPER – R	
TURNING VANES	
FLEXIBLE DUCT FLEXIBLE CONNECTION	
GOOSENECK HOOD (COWL)	
BACK DRAFT DAMPER	BDD

SYMBOL MEANING	SYMBOL
SUPPLY GRILLE (SG)	508 x 305 SG 330 LPS
RETURN (RG) OR EXHAUST (EG) GRILLE (NOTE AT FLR OR CLG)	508 x 305 RG 330 LPS
SUPPLY REGISTER (SR) (A GRILLE + INTEGRAL VOL. CONTROL)	508 x 305 SR 330 LPS
EXHAUST OR RETURN AIR INLET CEILING (INDICATE TYPE)	508 x 305 GR 330 LPS
SUPPLY OUTLET. CEILING, ROUND (TYPE AS SPECIFIED) INDICATE FLOW DIRECTION	508 330 LPS
SUPPLY OUTLET. CEILING, SQUARE (TYPE AS SPECIFIED) INDICATE FLOW DIRECTION	305 x 305 330 LPS
TERMINAL UNIT. (GIVE TYPE AND OR SCHEDULE)	T.U.
COMBINATION DIFFUSER AND LIGHT FIXTURE	
DOOR GRILLE	DG 305 x 152
SOUND TRAP	ST
FAN & MOTOR WITH BELT GUARD & FLEXIBLE CONNECTIONS	
VENTILATING UNIT (TYPE AS SPECIFIED)	
UNIT HEATER (DOWNBLAST)	
UNIT HEATER (HORIZONTAL)	
UNIT HEATER (CENTRIFUGAL FAN) PLAN	
THERMOSTAT	T
POWER OR GRAVITY ROOF VENTILATOR – EXHAUST (ERV)	
POWER OR GRAVITY ROOF VENTILATOR – INTAKE (SRV)	
POWER OR GRAVITY ROOF VENTILATOR – LOUVERED	
LOUVERS & SCREEN	914 H x 610 L

FIGURE 10–1M SYMBOLS FOR HVAC SYSTEMS (SI)



FLOOR PLAN

This figure illustrates a sample layout of supply and return duct systems in one floor of a multistory light manufacturing plant.

The floors serve as the horizontal fire separation and penetrations require a fire damper (◆).

The suspended ceilings are not required to be fire resistive. Corridor walls are required to be one-hour construction and are extended to the underside of the floor slab. A fire damper may be required by local authorities at each penetration of the one-hour corridor walls. Where there are no fire dampers, ductwork will be fire-stopped on each side of the one-hour wall.

Office rooms adjacent to each other do not require fire-resistive separations between each office; therefore, fire dampers are not required.

Approved fire dampers are required where ducts (or grilles) penetrate partitions that have a fire resistance rating of two hours or more. Some codes require fire dampers in one-hour walls other than corridors.

Fire-resistive separations are required between the office and laboratory, the laboratory and spray painting, and the office and paper storage because of a difference in occupancy. Such separations are extended through the suspended ceilings to the underside of the floor above.

Fire dampers (shown by - ▶) are required at each penetration of these required fire-resistive separations which are rated at two hours or more.

Fire dampers are required at each entry to the exhaust shaft in the women's room, and in the janitor closet, and also at each supply and return shaft connection in the office. Exhaust ducts from the laboratory and spray painting rooms should be enclosed in separate non-combustible fire-rated shafts in accordance with the code having jurisdiction.

If the building construction were a floor-ceiling assembly system similar to that in Figure 11-2, ceiling opening protection would be required at each supply, return and exhaust opening in the ceiling. Ceiling openings would be designed with (▶◀) heat stop symbols.

FIGURE 10-2 SAMPLE APPLICATION OF SYMBOLS TO PLANS

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CHAPTER 11

APPLICATIONS

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11.1 APPLICATION EXAMPLE NO. 1 REFER TO FIGURE 11–1

DETAIL "A". Where a fire-rated floor system (1A) provides the entire required fire resistance between stories of a building, fire dampers are not required where penetrations are made through the nonrated suspended ceiling (2A) below the floor system. Where ducts penetrate two-hour or more fire-rated construction, such as corridor walls (3A), fire dampers (4A) are to be provided at each penetration of the two-hour or more rated fire-resistive construction.

Where exit corridors are provided, the corridor is to be separated from the remainder of the building by walls and ceilings of usually not less than one-hour fire-resistive construction as determined by the local building code. In this application, two-hour rated walls protect a corridor because the walls may constitute an area or occupancy separation. Penetration of each occupancy or area separation wall by the duct requires a fire damper. A one and a half hour rated fire damper provides the required protection for such two hour rated walls.

DETAIL "B". Where ducts penetrate a specially constructed fire-rated ceiling, such as an exit corridor (1B), fire dampers (2B) should be provided at the point of penetration of the rated fire-resistive construction. The alternate for Detail "B" has a standard horizontal fire damper installation above a dropped unrated lay-in ceiling.

In this application the exit corridor walls (3B) do not extend to the underside of the floor above; therefore, the exit corridor ceiling is to be constructed, by the ceiling contractor, of an assembly of materials having a fire-resistive rating equal to that of the corridor walls. Penetration of this ceiling by a duct requires a horizontal fire damper (2B) at the point of penetration.

The horizontal fire damper (2B) in the corridor ceiling could be a damper similar to 5B, if it has been tested in a horizontal position. The damper used may be similar to the vertical fire damper (5B), in the corridor wall, except that the damper will be designed for operation in a horizontal position.

Ceiling (1B) should be constructed, by the ceiling contractor, of supporting members, and covered on each side with fire-resistive materials. Protection of the supporting members is required on both the upper and lower side of the members. Only horizontal tested fire dampers may be used for this type of assembly.

The ceiling penetration of duct (4B) does not require a fire damper or opening protection because the ceiling is not a portion of a fire-rated assembly.

No fire damper or opening protection is required in penetrations through the suspended ceiling (6B) because the ceiling is not a portion of a fire-rated assembly.

DETAIL "C" is a construction similar to Detail "A" except that the corridor ceiling space is used for supply and return ducts. Each penetration of the two-hour fire-rated corridor wall requires a fire damper (1C) whether the penetration is above or below the ceiling (2C) which is supplemental to the floor system. No protection is required for ceiling openings (3C) since the ceiling is not a portion of a fire-rated assembly.

NOTE: ACCESS DOORS IN DUCTS AND CEILINGS ARE NOT SHOWN.

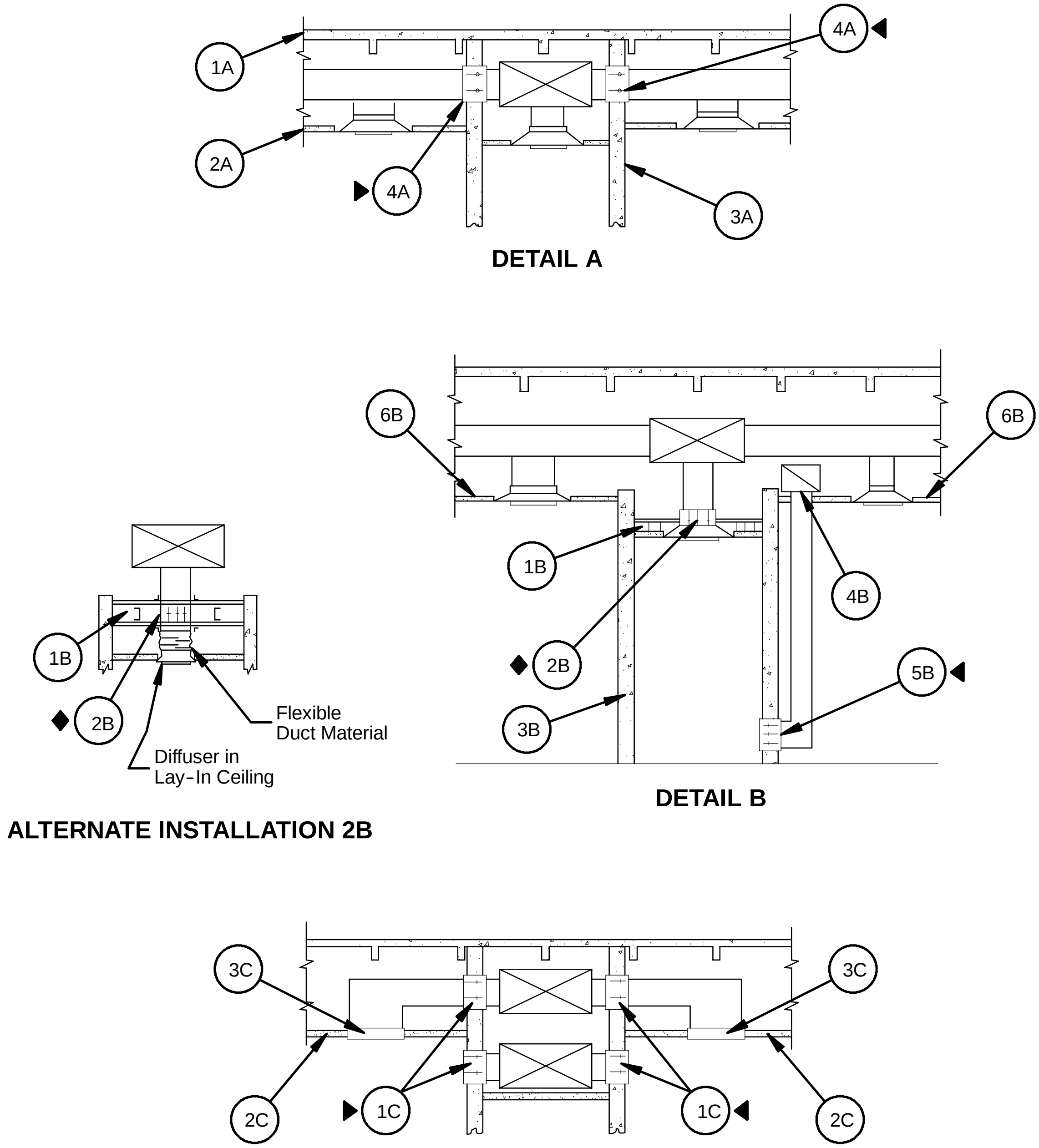

FIGURE 11-1 APPLICATION EXAMPLE NO.1

11.2 APPLICATION EXAMPLE NO. 2 REFER TO FIGURE 11–2

DETAIL "A". Where a combination floor-ceiling assembly, composed of floor (1A), supporting members (2A), and the ceiling (3A), provides the required fire endurance between stories in a building, ceiling opening protection (4A) (5A) is required where penetrations are made through the ceiling. Protection of the ceiling opening by heat stops or radiation dampers is required to maintain the fire endurance rating of the ceiling.

Where exit corridors are provided, the corridor is usually required to be separated from the remainder of the building by walls and ceilings of not less than one-hour fire-resistive construction. Penetration of the corridor ceiling for an air outlet shall be protected in accordance with the conditions of approval of the floor-ceiling assembly.

DETAIL "B". Where ducts penetrate a specially constructed fire-rated ceiling such as a ceiling of an exit corridor (1B), fire dampers (2B) should be provided at the point of penetration of the rated fire-resistive construction. The alternate for Detail "B" has a standard horizontal fire damper installation above a dropped nonrated lay-in ceiling.

In this application the exit corridor walls (3B) do not extend to the underside of the floor above; therefore the exit corridor ceiling is to be constructed by the ceiling contractor, of an assembly of materials having a fire endurance rating equal to that of the corridor walls. Penetration of this ceiling by a duct requires a horizontal fire damper (2B) at the point of penetration.

The horizontal fire damper (2B) in the corridor ceiling should be a damper which has been tested in a horizontal position. The damper used may be similar to the vertical fire damper (5B) in the corridor wall, except that the damper will be designed for operation in a horizontal position.

Ceiling (1B) should be constructed by the ceiling contractor of supporting members and covered on each side with fire-resistive materials. Protection of the supporting members is required on both the upper and lower side of the members. Only horizontal tested fire dampers should be provided for this type of assembly.

The ceiling penetration of duct (6B) requires opening protection be a radiation damper. The ceiling (4B) is required as a part of a fire-resistive assembly.

Opening protection should be provided at each penetration (7B) (8B) of the ceiling if required by the design of the assembly.

DETAIL "C". Shows the corridor ceiling space used for supply and return ducts. Each penetration of the corridor walls requires a fire damper (1C) whether the penetration is above or below the ceiling. A radiant ceiling damper (2C) or opening protection (3C) is required for openings in the ceiling. The ceiling is a required portion of the fire-rated assembly.

The use of particular forms of heat stops and radiation dampers in the illustrations does not denote preference for these designs. The ceiling assembly rating is normally contingent on use of selected alternatives and the maximum size of openings and number of openings is limited. For specific requirements for each floor/ceiling assembly, refer to UL Fire Resistance Directory.

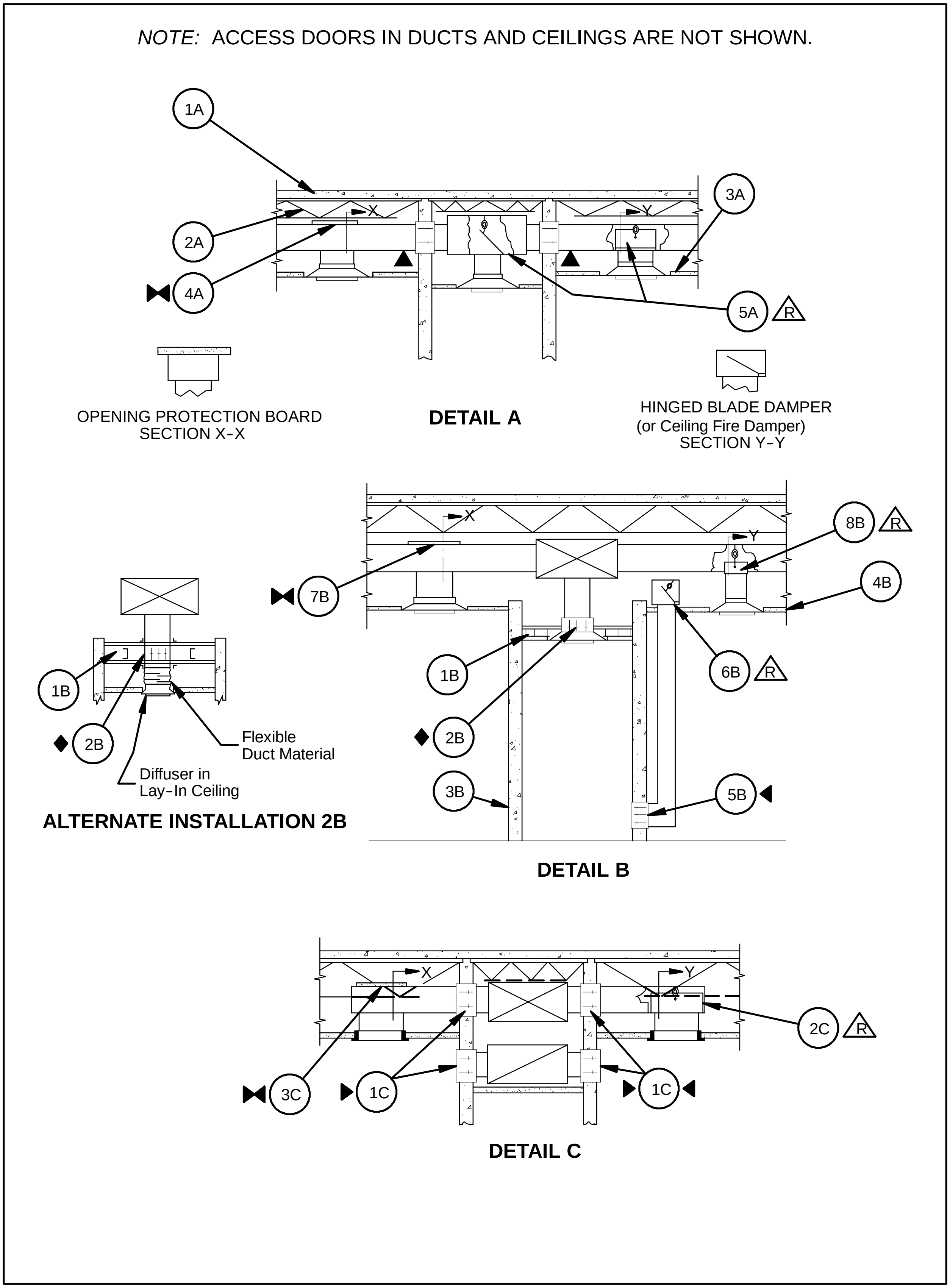

FIGURE 11-2 APPLICATION EXAMPLE NO. 2

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CHAPTER 12

SUBDUCTS

12.1 SUBDUCTS

Exhaust or return air only may be provided by a system of this type. Shaft walls are required to be fire-resistive, usually noncombustible construction, rated not less than one hour for buildings three stories or less in height and not less than two hours for buildings four stories or more in height. The shaft should be constructed air tight and extended to the roof.

Either fire dampers (1) or "subduct" assemblies (2) may be used for penetrations of the shaft waits. Subduct assemblies, regardless of their size, are to be extended upward a minimum of 22 inches (560 mm) from the top edge of the duct penetration. Fire stop subduct penetrations as required. Normal airflow in the return or exhaust riser is to be upward.

A fire damper (3) should be installed in the shaft wall. A return air or exhaust air duct connection is made from the fire damper to the return or exhaust fan (4). Penetrations such as fire damper (1) which occur above return or exhaust dampers (3) must be made with a fire damper. No subduct connections are allowed above penetration (3), since airflow at the subduct is required to be upward.

Refer to NFPA 90A and NFPA 204 for fan controls and operation of smoke and heat vents.

Subducts are to be constructed of galvanized sheet metal and should be of a gage recommended by the SMACNA duct construction standards for the size duct used.

Where subducts enter the shaft directly opposite each other, or if subducts are of a large size (6), it is important that the space occupied by the subducts will not create an obstruction to the flow of air within the shaft in the event of a fire. A rule of thumb generally followed is that the total area of subducts entering the shaft at the same level shall not equal more than 25% of the total shaft cross-sectional area.

Many local jurisdictions permit the use of the shaft for exhaust and return air systems without requiring the interior to be of metal duct. Consult the applicable codes for contingencies affecting the installation.

The subduct may also be used in lieu of a fire damper when a return duct riser or an exhaust riser is in the shaft. The subduct (7) may project into the duct or incorporate part of duct wall (8).

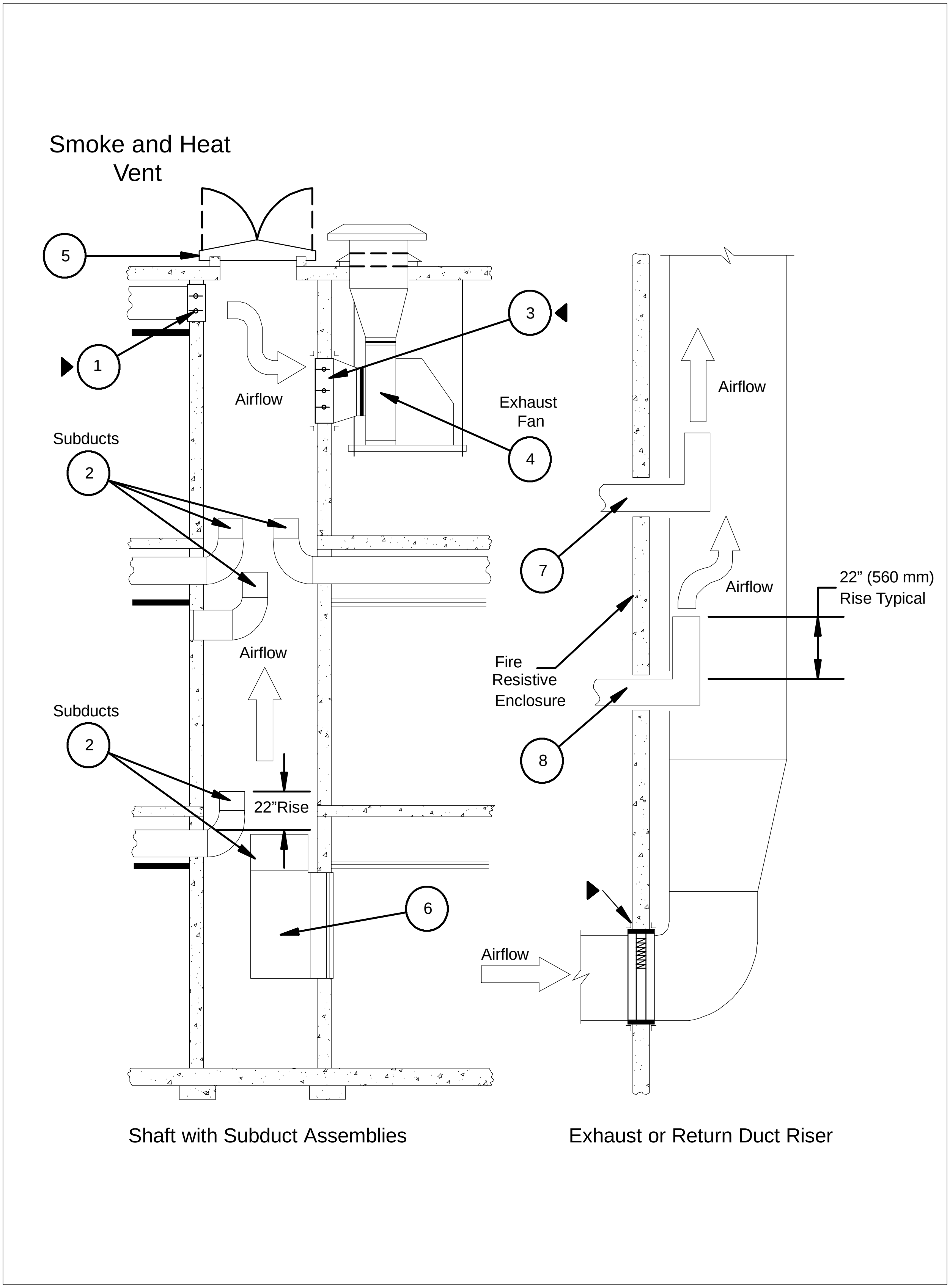
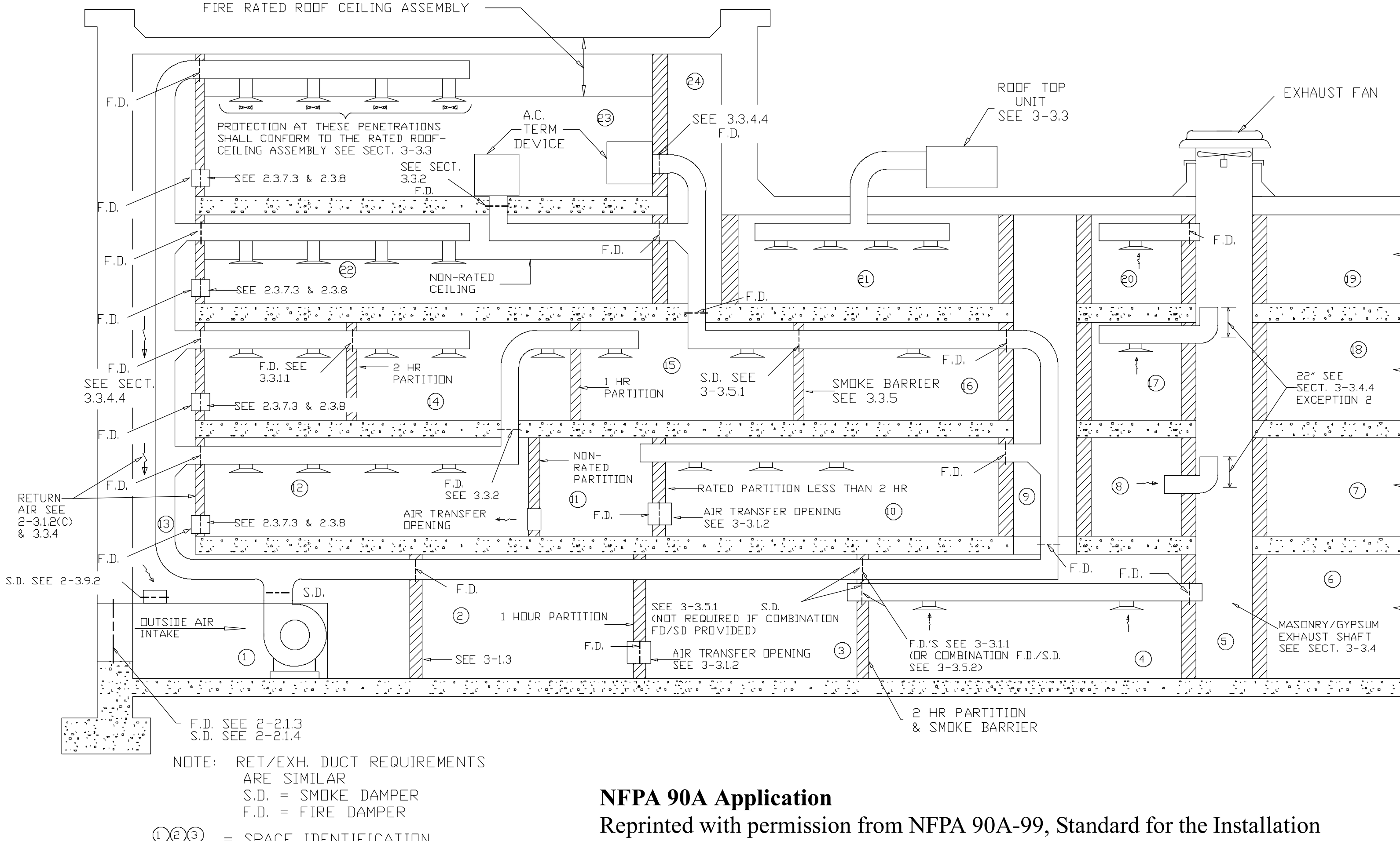


FIGURE 12-1 SUBDUCTS

APPENDIX A

NFPA 90A



NFPA 90A Application

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APPENDIX B

RANGE HOOD SYSTEMS

CHAPTER 1 GENERAL

1–1* SCOPE

1-1.1 This edition of NFPA 96 provides the minimum fire safety requirements (preventative and operative) related to the design, installation, operation, inspection, and maintenance of all pubic and private cooking operations except for single-family residential usage. These requirements include, but are not limited to, all manner of cooking equipment, exhaust hoods, grease removal devices, exhaust ductwork, exhaust fans, dampers, fire-extinguishing equipment, and all other auxiliary or ancillary components or systems that are involved in the capture, containment, and control of grease-laden cooking effluent.

1–3 GENERAL REQUIREMENTS

1-3.1 Cooking equipment used in processes producing smoke or grease-laden vapors shall be equipped with an exhaust system that complies with all the equipment and performance requirements of this standard, during all such equipment and performance shall be maintained per this standard during all periods of operation of the cooking equipment. Specifically, the following equipment shall be kept in good working condition:

(a) Cooking equipment

(b) Hoods

(c) Ducts (if applicable)

(d) Fans

(e) Fire suppression systems

(f) Special effluent or energy control equipment

All airflows shall be maintained. Maintenance and repairs shall be performed on all components at intervals necessary to maintain these conditions.

1-3.1.1* All solid fuel cooking equipment shall comply with the requirements of Chapter 11.

1-3.1.2 Multiple tenancy applications shall require the concerted cooperation of design, installation, operation, and maintenance responsibilities by tenants and by the building owner.

1-3.1.3 All interior surfaces of the exhaust system shall be reasonably accessible for cleaning and inspection purposes.

1–3.2* CLEARANCE

1-3.2.1 Except where enclosures are required hoods, grease removal devices, exhaust fans, and ducts shall have a clearance of at least 18 in. (457.2 mm) to combustible material, 3 in. (76.2 mm) to limited-combustible material, and 0 in. (0 mm) to noncombustible material. *[See Figures A-1-3.2(a) through (e).]*

Exception No. 1: Where the hood, duct, or grease removal device is for listed lesser clearances.

Exception No. 2: Reduced clearance to combustible material if the combustible material is protected as follows:

(a) 0.013 in. (0.33 mm) (28 gage) sheet metal spaced out 1 in. (25.4 mm) on noncombustible spacers shall have 9 in. (228.6 mm) clearance to combustible material.

(b) 0.027 in. (0.69 mm) (22 gage) sheet metal on 1 in. (25.4 mm) mineral wool bats or ceramic fiber blanket reinforced with wire mesh or equivalent spaced out 1 in. (25.4 mm) on noncombustible spacers shall have 3 in. (76.2 mm) clearance to combustible material.

See Figures A-1.3.2(f) and (g) for samples of clearance reduction systems.

Exception No. 3: Reduced clearance to limited-combustible materials to zero clearance where protected by metal lath and plaster, ceramic tile, quarry tile, other noncombustible materials or assembly of noncombustible materials, or materials and products that are listed for the purpose of reducing clearance and are acceptable to the authority having jurisdiction. The listed materials shall be installed in accordance with the conditions of the listing and the manufacturer's instructions and shall be acceptable to the authority having jurisdiction.

1-3.2.3.1 The specifications of material, gage, and construction of the duct used in the testing and listing of field applied grease duct enclosures and factory-built grease duct enclosures shall be included as mini-

mum requirements in their listing and installation documentation.

1-3.2.3.2* The following clearance options for which field applied grease duct enclosures and factory-build grease duct enclosures have been successfully evaluated shall be clearly identified in their listing and installation documentation and on their label.

(a) Open combustible clearance at manufacturer's requested dimensions

(b) Closed combustible clearance at manufacturer's requested dimensions, with or without specified ventilation

(c) Rated shaft clearance at manufacturer's requested dimensions, with or without specified ventilation

1-3.2.4 A duct shall be permitted to contact noncombustible floors, interior walls, and other noncombustible structures or supports, but it shall not be in contact for more than 50 percent of its surface area per each lineal foot of contact length. Where such direct contact is made, the duct shall be protected from corrosion due to this contact.

Exception: When the duct is protected with a material or product listed for the purpose of reducing clearance to zero.

1-3.2.5 For clearances between the duct and interior surfaces of enclosures, see 4-7.2.3.

1-3.3 A drawing(s) of the exhaust system installation along with a copy of operating instructions for subassemblies and components used in the exhaust system, including electrical schematics, shall be available on the premises.

CHAPTER 2 HOODS

2-1 CONSTRUCTION

2-1.1 The hood or that portion of a primary collection means designed for collecting cooking vapors and residues shall be constructed of and be supported by steel not less that 0.043 in. (1.09 mm) (No. 18 MSG) in thickness, stainless steel not less than 0.037 in. (0.94 mm) (No. 20 MSG) in thickness, or other approved material of equivalent strength and fire and corrosion resistance.

Exception: Listed exhaust hoods with or without exhaust dampers.

2-1.2 All seams, joints, and penetrations of the hood enclosure that direct and capture grease-laden vapors and exhaust gases shall have a liquidtight continuous external weld to the hood's lower outermost perimeter. Internal hood joints, seams, filter support frames, and appendages attached inside the hood need not be welded but shall be sealed or otherwise made greasetight.

Exception No. 1: Penetrations shall be permitted to be sealed by devices that are listed for such use and whose presence does not detract from the hood's or duct's structural integrity.

Exception No. 2: Eyebrow-type hoods over gas or electric ovens shall be permitted to have a duct constructed as in Chapter 4 from the oven flue(s) connected to the hood canopy upstream of the exhaust plenum as shown in Figure 2-1.2. The duct shall be connected to the hood with a continuous weld or have a duct-to-duct connection as shown in Figures 5-1.2.1(b), (c), or (d).

Exception No. 3: Seams, joints, and penetrations of the hood shall be permitted to be internally welded, provided that the weld is formed smooth or ground smooth, so as to not trap grease, and is readily cleanable.

Exception No. 4: Listed exhaust hoods with or without exhaust dampers.

CHAPTER 4 EXHAUST DUCT SYSTEMS

4-1 GENERAL

4-1.1 Ducts shall not pass through firewalls or fire partitions.

4-1.2* All ducts shall lead as directly as is practicable to the exterior of the building, so as not to unduly increase any fire hazard.

4-1.3 Duct systems shall not be interconnected with any other building ventilation or exhaust system.

4-1.4 All ducts shall be installed without forming dips or traps that might collect residues. In a manifold (common duct) systems, the lowest end of the main duct shall be connected flush on the bottom with the branch duct.

4-1.5 Openings required for accessibility shall comply with Section 4-3.

4-1.6 A sign shall be placed on all access panels stating the following:

ACCESS PANEL—DO NOT OBSTRUCT

4-5.1 **Materials.** Ducts shall be constructed of and supported by carbon steel not less than 0.054 in. (1.37 mm) (No. 16 MSG) in thickness or stainless steel not less than 0.043 in. (1.09 mm) (No. 18 MSG) in thickness.

4-5.2 Installation

4-5.2.1 All seams, joints, penetration, and duct-to-hood collar connections shall have a continuous external weld.

Exception No. 1: Duct-to-hood collar connections as shown in Figure 4-5.2.1 shall be permitted.

Exception No. 2: Penetrations shall be permitted to be sealed by other listed devices that are tested to be greasetight and are evaluated under the same conditions of fire severity as the hood or enclosure of listed grease extractors and whose presence does not detract from the hood's or duct's structural integrity.

Exception 3: Internal welding shall be permitted, provided the joint is formed or ground smooth and is readily accessible for inspections.

4-5.2.2 Overlapping duct connections of either the telescoping or the bell type shall be used for welded field joints, not butt-weld connections. The inside duct section shall always be uphill of the outside duct section. The difference between inside dimensions of overlapping sections shall not exceed ¼ in. (6.4 mm). The overlap shall not exceed 2 in. (50.8 mm). *(See Figure 4-5.2.2.)*

4-8* Termination of Exhaust System

4-8.1 The exhaust system shall terminate as follows:

(a)* Outside the building with a fan or duct

(b) Through the roof, or to the roof from outside, as in 4-8.2, or through a wall, as in 4-8.3

CHAPTER 6 AUXILIARY EQUIPMENT

6-1 Dampers. Dampers shall not be installed in exhaust ducts or exhaust duct systems.

Exception: Where specifically listed for such use or where required as part of a listed or approved device or system.

*NOTE: An asterisk (*) following the number or letter designating a paragraph indicates explanatory material on that paragraph in Appendix A of NFPA 96-98.*

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APPENDIX C

HEAT STOP PERFORMANCE

The three types of ceiling outlet protection were subjected to the UL Standard Fire Test and their relative performances were recorded as follows:

Average Unexposed Surface Temperature (°F) / **Maximum Unexposed Surface Temperature (°F)**

Time (min)	Avg. Duct No. 1	Avg. Duct No. 2	Avg. Duct No. 3	Max. Duct No. 1	Max. Duct No. 2	Max. Duct No. 3
30	114	115	113	122	124	119
60	210	214	216	226	235	219
90	303	312	304	323	340	311
120	395	405	396	430	436	406
180	530	545	533	570	576	546
240	628	644	630	657	672	648

Average Joist Temperature Temperature (°F) / **Average Top Chord Joist Temperature (°F)**

Time (min)	Joist Duct No. 1	Joist Duct No. 2	Joist Duct No. 3	Top Chord Duct No. 1	Top Chord Duct No. 2	Top Chord Duct No. 3
30	459	392	456	394	391	462
60	596	538	607	535	543	600
90	707	646	708	659	650	710
120	798	746	800	753	753	802
180	928	894	949	902	908	928
240	1026	1008	1059	1000	1018	1038

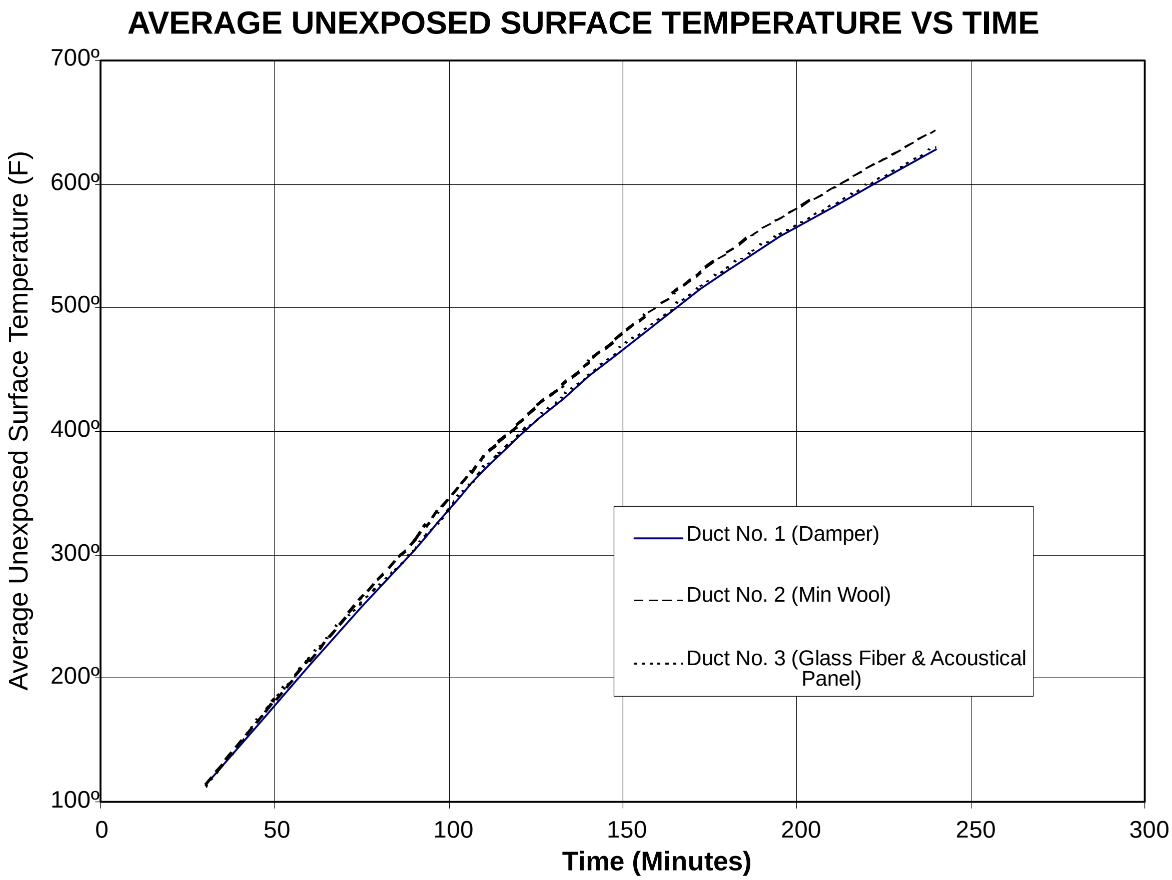
Graphs of average unexposed surface temperatures and average joist temperatures are shown in Figures C-1 and C-2 of Appendix C. The tables and the figures illustrate (comparatively) the closeness of the performance of these alternatives

Ceiling No. 1-The duct outlet was protected by a damper of 16 gauge galvanized sheet steel fitted into the duct above the duct drop. The damper was faced on both sides with 1/16 inch asbestos paper*, and it was hinged on one edge, ready to drop over the opening when released by a fusible link (*See* Figure 9-2.)

Ceiling No. 2-The duct outlet was protected by a tent fabricated from mineral wool batts. The batts were arranged to extend beyond the top and sides of the duct, and to extend laterally about 6 inches beyond the duct opening. (*See* Figure 9-3, System B.)

Ceiling No. 3-This duct was internally lined with a 1 inch thick fibrous glass liner which extended 1 foot beyond the edges of the outlet. The duct outlet was also protected by 5/8 inch thick acoustical panels placed on top of the duct. The acoustical panels extended 18 inches longitudinally and 6 inches laterally beyond the duct outlet. (*See* Figure 9-3, System A.)

NOTE: Ceiling No. 1 tests were conducted with 1/16 inch asbestos paper. An approved fire resistant insulation now must be used in lieu of the asbestos paper.



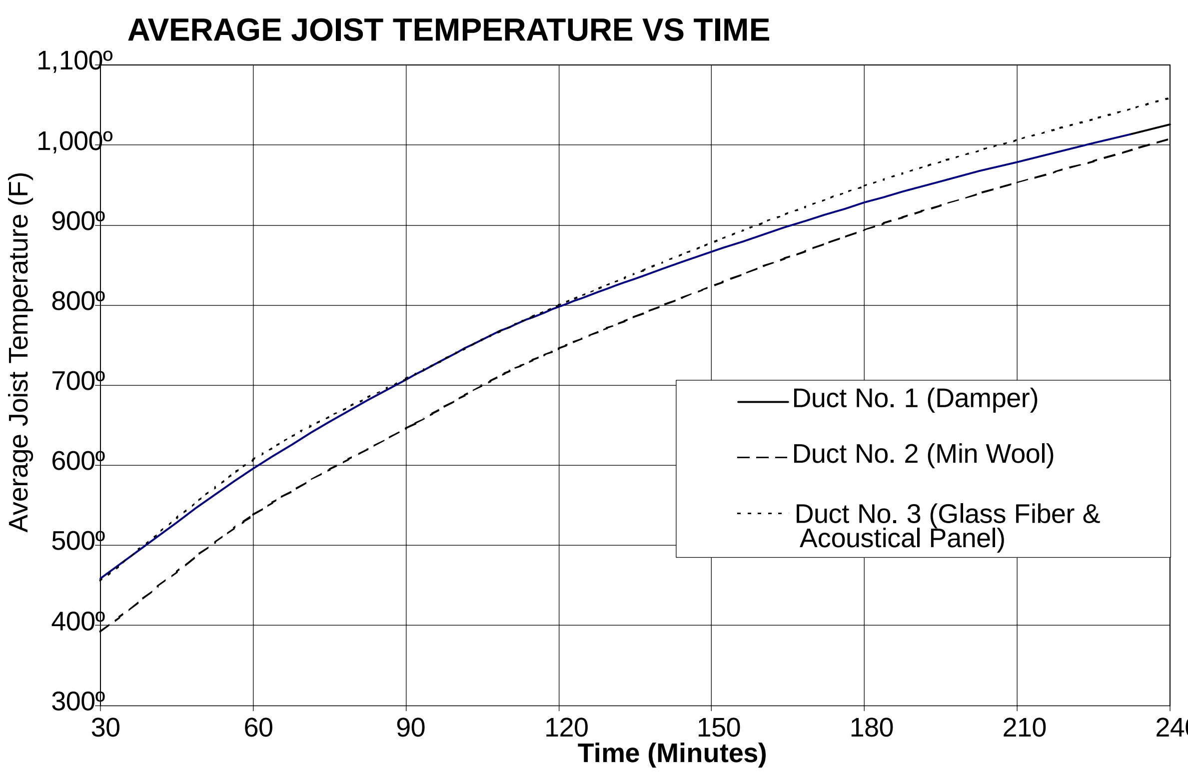


FIGURE C-1 & C-2 HEAT STOP PERFORMANCE

APPENDIX D

ACCEPTANCE TESTS GUIDE

D.1 GENERAL

The acceptance test criteria for fire and smoke control systems should be adequately described in the contract documents. They should be based on the requirements of the applicable code and on any special test needed to verify compliance of the system of the design intent. **IT IS IMPORTANT THAT THE TEST PROCEDURES, TEST DOCUMENTATION, TERMS OF ACCEPTANCE INCLUDING PARTIES TO WITNESS THE TESTS AND TO APPROVE THE TESTS BE CLEARLY DESCRIBED IN THE CONTRACT DOCUMENTS.** The model codes vary in the specificity of the final acceptance tests and documentation. *The Uniform Building Code-1997*, *The International Building Code-2000* and the *International Fire Code-2000* contain the most detailed descriptions. The requirements in the International codes are similar to those in the *Uniform Building Code*.

Other publications which provide guidance on smoke control system testing and which may be referenced in the contract documents are *ASHRAE Guideline 5-1994 (RA 2001), Commissioning Smoke Management Systems; NFPA 92A-2000, Recommended Practice for Smoke-Control Systems* and *NFPA 92B-2000, Guide for Smoke Management Systems in Malls, Atria, and Large Areas.* Each of the documents stresses documentation of the test procedure and the test results.

The following summarizes the common steps for successful smoke control system acceptance testing:

1. System objectives
2. Inspection
3. Component testing
4. Functional testing
5. Performance testing
6. Documentation

D.2 SYSTEM OBJECTIVES

It is vital to the success of the acceptance test that the objectives and the sequences of operation of the fire and smoke control system be adequately described in the contract documents and that the design intent of the system be clearly described. The test procedures, test documentation and terms of acceptance including all of the parties which must approve the results of the tests must be included in the contract documents.

D.3 INSPECTION

Prior to conducting tests, verify that the required components are installed in accordance with the manufacturer's installation instructions and the contract documents and that all of the required devices are in place and connected. Building architectural features such as shaft integrity, fire stopping, doors and partitions are generally not needed for component testing but will need to be in place before final performance tests can be performed.

D.4 COMPONENT TESTING

This step consists of operational testing of each individual component to determine if it performs properly. For example, each fire and smoke damper should be checked to see that it is installed in the correct location and direction and that it closes or opens as required by the contract documents.

D.5 FUNCTIONAL TESTING

In this step, subsystems are tested to determine that they function as required. For example, this could entail activating a smoke detector and checking to see that fans and dampers achieve the correct positions. For those systems which are designed to operate with the fan shut down and do not use damper actuators, no testing beyond component testing is necessary.

Systems which are designed to operate with the fan shut down and which use damper actuators should be tested to verify that the damper actuator and the damper function properly on receiving a signal.

D.6 PERFORMANCE TESTING

The first task in this step should be to confirm the objective of the system and the test protocol in addition to the items mentioned in the General Section. Before beginning the tests, it should be confirmed that all required parties are present and copies of the test procedures should be given to them.

If any of the contractors believe that the use of the approved procedures could cause personal injury or system damage, they must make their concerns known to the appropriate authority in a timely manner.

Under performance testing, all of the systems and building architectural features should be in place. The purpose of the tests is to demonstrate that the correct output is achieved for each input for each control sequence specified. The tests will generally start under normal mode. Automatic mode or manual or override

mode is usually required to be tested on both normal and standby power.

This type of testing may not be appropriate if adequate safety provisions to prevent system damage are not provided. Those safety provisions could include positive and negative pressure relief devices, additional duct reinforcing, fan speed control and motor actuated dampers.

D.7 DOCUMENTATION

It is crucial to successful acceptance testing to document what has been tested, when it has been tested, who tested it and what the results were at each of the steps previously outlined. The Uniform and the International codes require the components be tagged or marked with identification of when the component was tested and by whom. Those identifications are to be included in test reports and on final contractor record drawings. The contract documents should clearly state whether and to what extent the tagging requirements are to be invoked. They should also describe the nature of the identification or tag.

D.8 CAUTION

Operational testing of dynamic dampers under airflow conditions can cause spikes in duct static pressure which may be significantly higher than the duct operating or classification pressure resulting in structural failure of the duct. If this type of test is required, designers must include provisions to accommodate these pressure transients in the contract specifications.

APPENDIX E

SMOKE DETECTORS IN DUCT APPLICATIONS

E.1 PURPOSE

The purpose of this appendix is to provide information on air duct smoke detectors so that they may be properly located and installed.

E.2 TERMINOLOGY

Air Distribution System. A continuous passageway that, in addition to air ducts, can include air connectors, air direct fittings, dampers, plenums, fans, and accessory air-handling equipment but that does not include conditioned spaces.

Air Duct. A conduit made of sheet metal or other suitable material used for conveying air.

Air Sampling-Type Detector. Consists of air sampling ports at ends of piping or tubing extending from the detector unit to the areas to be protected. A pump draws air from the protected area through the ports or tubing to the detector where the air is analyzed for fire products.

Area-Type Smoke Detector. A smoke detection device which contains the sampling and sensing components in a single unit. They may be ionization smoke detectors or photoelectric light scattering detectors. They are generally called spot-type detectors.

Cloud Chamber Smoke Detector. A smoke detection device. This type of smoke detector draws a sample of air into a high humidity chamber in the detector. When smoke particles are present in the sensing chamber, the moisture condenses on the particles forming a cloud. The density of the cloud is measured. When the density is greater than a predetermined level the detector responds.

CFM. Cubic feet per minute; volume of airflow.

Duct-Type Smoke Detector. A device located within the duct, or mounted on the outside of the duct with sensing elements protruding into the duct, that will detect the visible and invisible particles of combustion flowing within the duct. Actuation of the device may allow operation of certain control devices to restrict the spread of smoke.

Environmental Air. Air which is supplied, returned, recirculated, or exhausted from spaces for the purpose of controlling the atmosphere within the building.

Sampling Tube. A tube that provides a path for sampled air to reach the detector from the duct.

FPM. Feet per minute; air velocity

Ionization Detector. A smoke detection device. This type of smoke detector contains a small amount of radioactive material which ionizes the air in the sensing chamber. The ionization of the air permits an electrical current to flow. When smoke particles are present in the sensing chamber electric conductance is lessened. When the conductance falls below a predetermined level the detector responds. This type of detection is most responsive to invisible smoke produced by most flaming fires.

Line-Type Smoke Detector. The detection is continuous along a path. A photoelectric light obscuration detector (projected beam detector) is an example of a line smoke detector.

Photoelectric Light Obscuration Detector. A smoke detection device. This type of smoke detector has a photosensitive sensor and a light source which projects long beams of light. For this reason this type of detector is usually installed in large plenums or ducts rather than small ducts. When smoke is present in the duct or plenum some of the light rays from the source are scattered and some are absorbed. This reduces the light to the sensor and the detector responds. This type of detection is usually not affected by the color of the smoke. Also called a projected beam detector.

Photoelectric Light Scattering Detector. A smoke detection device. This type of smoke detector uses a light source and a photosensitive sensor. When smoke is present, rays from the light source are scattered by reflection and refraction into the sensor and the detector responds. This type of detection is most responsive to visible smoke produced by most smoldering fires. It is less responsive to black smoke and to the smaller particles typical of flaming fires.

Projected Beam-Type Detector. A type of photoelectric light obscuration smoke detector wherein the beam spans the protected area.

Sensitivity. For spot-type smoke detectors the sensitivity is measured in percent per foot obscuration.

Smoke. The airborne solid and liquid particulates and gases evolved when a material undergoes pyrolysis or combustion, together with the quality of air that is entrained or otherwise mixed into the mass.

Smoke Detector. A device that detects visible or invisible particles of combustion.

Spot-Type Smoke Detector. A smoke detection device which contains the sampling and sensing compo-

nents in a single unit. They may be ionization smoke detectors or photoelectric light scattering detectors. They generally are called spot-type detectors.

E.3 SMOKE DETECTORS

E.3.1 General

An air distribution system has the potential to convey smoke from area to area. For this reason smoke detection in the duct system is essential to safety to life and protection of property. Smoke detectors are installed in all areas where required by the authority having jurisdiction. For the following reasons detectors placed in environmental air ducts are not used as a substitute for open area smoke detectors: (a) When the ventilating system is on, the detector(s) may be less responsive to a fire condition due to dilution by clean air. (b) When the ventilating system is off, smoke may not be drawn into the duct.

E.3.2 Design

Smoke detectors in air ducts are designed to detect the presence of smoke and automatically stop or start their respective fan(s) to prevent the spread of smoke through the air distribution system. Air duct smoke detectors are not a substitute for open area smoke detectors.

E.3.3 Selection

The selection of smoke detectors is based on both the design characteristics of the detector and the area of installation. Select detectors for proper operation over the complete range of air velocities, temperature, and humidity expected at the detector when the air distribution system is operating.

E.3.4 Duct–Type Smoke Detectors

Duct–type smoke detectors are generally classified as spot-type, air sampling, or projected beam. They may be mounted in the duct or within an enclosure on the outside of the duct with the sampling or sensing element protruding into the duct.

E.3.5 Signaling System

Duct–type smoke detectors connected to a building protective signaling system will cause a visual or audible signal to be indicated at a normally occupied location upon the activation of any detector. Duct-type smoke detectors are not a substitute for a building's regular fire detection system.

E.3.6 Detector Sensitivity

Dust, dirt and other foreign matter can accumulate inside the smoke detector and change its sensitivity. If the detector becomes too sensitive it may cause unwanted alarms. On the other hand, if the detector becomes less sensitive its level of protection may be reduced.

E.3.7 System Operation

To restrict the spread of smoke through the air distribution system the supply fan shuts off when a duct smoke detector senses smoke. Depending on a sequence of operation, if there is a return fan it may also shut off and all automatic control dampers may close. Another sequence of operation has the return fan operating and the exhaust damper open to exhaust the smoke from the space. Because there are a number of smoke detection and control sequences, it is essential that all concerned understand the system operation. The sequence must be coordinated with the smoke management system so that the duct-type detector does not shutdown fans which are intended to run during smoke mode. This is allowed by the exception to paragraph 4-4.2 of NFPA 90A.

E.4 INSTALLATION

E.4.1 Location

The location of smoke detectors is based on an evaluation of conditions such as the burning characteristics of the combustible materials in the building and the construction of the air distribution system. To prevent false operation, unwanted alarms, or nonoperation, the placement of smoke detectors must be considered so that the normal sources of smoke, moisture, dust, fumes, etc., in the air distribution system do not hinder the detector. Follow the manufacturer's guidelines for proper location. Permanently and clearly identify the location of all air duct smoke detectors.

E.4.2 General

Install duct-type smoke detectors in such a way as to obtain a representative sample of the air stream. Rigidly mount the air duct smoke detector. Depending on the type of detector, it should be mounted within the duct or mounted on the outside of the duct with the sensing element protruding into the duct. Refer to mounting instructions from the manufacturer. Install sampling tube smoke detectors so that the airflow from the duct to the detector can be verified. Smoke detectors should be either cleaned or replaced if they were installed prior to final inspection and acceptance.

Refer to local codes for installation locations.

E.4.3 Inspection

Inspect each detector to ensure that it is properly located, mounted and connected in accordance with the manufacturer's recommendations. Test and record the initial detector sensitivity.

E.4.4 Installation Reports

The installation report includes the following information: date; name of property and address; installer, affiliation, business address, and telephone number; approving agency, representative, business address, and telephone number; number, type and designation of detector(s); and signature(s) of installer and authority representative if required.

The contractor record drawings, operation and maintenance manuals, and test documents required by the contract documents should be provided.

E.4.5 Maintenance

Smoke detectors should be maintained in accordance with the manufacturer's instructions.

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APPENDIX F

SMOKE MANAGEMENT

F.1 PURPOSE

The purpose of this appendix is to provide information on active (mechanical) and passive smoke control systems. It is not intended to be a design manual.

F.2 TERMINOLOGY

Air pressure Differential (Difference). A measurement specified in inches of water, gage between two points in a duct or other air passage, or between two spaces.

Design Fire. A determination based on a rational engineering analysis of the characteristics of the fuel, fuel load, effects induced by the fire and whether the fire is likely to be steady or unsteady. The determination is made by the design engineer and approved by the building official.

HVAC. Heating, Ventilating and Air-Conditioning.

Pressurized Stairway. A mechanical smoke control system. Fans are used to pressurize the stairway enclosure (stair shafts) with outside air to minimize smoke contamination during a fire.

Pyrolysis. The decomposition of a substance by heat.

Smoke. The airborne solid and liquid particulates and gasses that evolve when a material undergoes pyrolysis or combustion.

Smoke Barrier. *See* Chapter 2.

Smoke Control Mode. The defined operation of a system or device for the purpose of smoke control.

Smoke Control System. An engineered system for controlling the migration of smoke. Design of the smoke control system should consider the buoyancy and expansion caused by the design fire.

Smoke Control System, Mechanical. A smoke control system using fans to produce airflows and pressure differences across openings, spaces or smoke barriers, or between smoke control zones to limit and direct smoke movement.

Smoke Control System, Passive. A smoke control system using smoke barriers to limit smoke movement.

Smoke Control Zone. *See* Chapter 2.

Smoke Damper. *See* Chapter 2.

Smoke Exhaust System. A mechanical or gravity system intended to move smoke from the smoke zone to the exterior of the building, including smoke removal, purging, and venting systems, as well as the function of exhaust fans used to reduce the pressure in a smoke zone.

Smoke Exhaust Shaft. A vented, fire-resistive shaft.

Smoke Management System. An engineered system that includes all methods that can be used singly or in combination to modify smoke movement.

Smoke Zone. The smoke control zone in which the fire is located.

Temperature Effect. The temperature difference between the exterior and interior of the building that creates stack effect and determines the direction and magnitude of the airflow.

Tenable Environment. An environment which does not contain enough smoke to prevent evacuation through it.

Zoned Smoke Control. *See* Chapter 2.

F.3 INTRODUCTION

Fires produce smoke which if not controlled or managed in some way will spread to endanger life and property. Even small fires produce a large volume of smoke. Smoke can spread in buildings through construction cracks, pipe penetrations, and open doors in addition to action of the air distribution system. The principle driving forces of smoke movement are stack effect, buoyancy and expansion of the combustion gases caused by increased temperature, weather (principally wind and temperature) and the air distribution or the HVAC system.

The objective of a smoke control system should be to maintain a tenable environment in the means of egress, to limit or control smoke spread from the fire area and to aid fire fighters or other emergency responders in their search and rescue efforts.

F.4 SMOKE MANAGEMENT SYSTEMS

As previously defined, smoke management systems include all methods that can be used singly or in combination to modify smoke movement. These systems are described in *NFPA 92B*. They particularly involve

exhaust or venting to manage smoke found in atria or covered malls and other large spaces such as arenas.

F.4.1 SMOKE MANAGEMENT SYSTEM DESIGN TASKS

There are four principle tasks to be accomplished when planning a smoke management system. They are as follows:

1. Establish objectives
2. Estimate the fire size
3. Calculate smoke production
4. Document the calculations and design

F.4.1.1 Establish Objectives

This is vital to achieving successful smoke management system design. This matter has been previously discussed.

F.4.1.2 Estimate the Fire Size

For smoke management system used for an atrium or covered mall, estimating the fire size is a significant issue. The means to limit the size of the fire is needed to achieve a credible maximum fire size. Typically, this is accomplished by fire suppression systems such as automatic sprinklers. It could be achieved by controlling the combustibles, but this is generally not a credible approach.

F.4.1.3 Calculate Smoke Production

Based on the fire size, the dimensions and other physical features of the space, the smoke production rate is to be calculated if the system is a smoke management system for an atrium or covered mall. Means to perform these calculations are described in the model codes, in Chapter 51 of the ASHRAE *Handbook* and in *NFPA Standard 92B* among other publications.

If the system is a smoke management system depending on pressure differential, then the calculation of the smoke production rate is not needed. It is necessary, however, to calculate the pressure difference across boundaries to achieve the minimum pressure required by the code intended to protect occupants from smoke spread induced from stack effect, buoyancy, wind and elevator piston effect.

F.4.1.4 Document the Calculations and Design

Finally, it is imperative that the assumptions and calculations used in the design be well documented.

The remainder of this section describes specific issues to be considered in designing and installing smoke management systems.

F.5 SMOKE CONTROL SYSTEMS

Smoke control systems are a subset of smoke management systems. They use mechanical fans to produce airflows and pressure differences across barriers to limit smoke movement. They are described in *NFPA 92A*. Stair pressurization, zoned smoke control and pressure sandwich systems are examples of smoke control systems.

F.5.1 Smoke Control System Design Considerations

The first step in designing a smoke control system is to establish the system objective and then method of test to determine compliance with the objective. The objective should be based on an analysis of the building occupancy and construction. Among the factors to consider are the following:

1. Occupant egress
2. Fire suppression
3. Building height

F.5.1.1 Occupant Egress

Whether occupants can leave the building before they are endangered by smoke will determine the type of smoke management system to be used. The zoned smoke control pressure sandwich system would be used for a high-rise building, hospital or detention facility because occupants would need to be protected in place or because limited occupant movement would be required or allowed. Such systems consist of stair pressurization and zoned smoke control. The zoned smoke control would exhaust the fire area or floor and pressurize adjacent areas or floors. When applied to an entire floor in a high rise building, this type of system is referred to as a pressure sandwich system.

For a low-rise building where occupants can exit in a short time before they would be endangered by smoke, all that may be needed is to shut down air circulation systems to prevent spreading smoke around the building.

F.5.1.2 Fire Suppression

The fire suppression system, particularly an automatic sprinkler system, will affect the smoke control system because it will determine the maximum size fire expected. The quantity and toxic nature of the smoke is reduced as the fire size is controlled. A fire controlled by automatic sprinklers will likely create a visibility hazard, but should not pose a temperature or other toxic hazard for a limited exposure time. If a means to control or extinguish a fire is not provided, the smoke control system is likely to have a limited duration and could require higher temperature protection for components.

F.5.1.3 Building Height

Smoke spread in low-rise buildings is primarily affected by influences of the fire, that is heat, convection and pressure. Smoke spread in high rise buildings is affected by these factors by primarily by stack effect and to a lesser extent by the elevator piston effect.

F.6 SYSTEM GUIDELINES

F.6.1 Air Leakage Control

To control air leakage through adjacent smoke zone boundaries, ducts in interior smoke zone boundaries are to have smoke dampers tested in accordance with UL555S. The leakage rating, including leakage class, static range and temperature rating must be specified. Smoke dampers which are also volume control dampers shall be so listed.

When a greater rating is required due to the location of the opening, specify labeled and listed fire door assemblies be provided with listed gasketing. Doors in interior smoke zone boundaries are to be minimum 20-minute smoke-and-draft control doors tested in accordance with UL1784, *Standard for Air Leakage Tests for Door Assemblies.* All doors in interior smoke zone boundaries are to be maintained self-closing or be automatic closing by smoke detection. Movement of smoke through elevator hoistways should be restricted using methods such as pressurization of the shaft or the provision of vestibules.

Floor construction is to be tight against the exterior walls. All openings such as the space around pipes, ducts, conduits and damper sleeves is to be sealed to limit air leakage. Ducts which penetrate floors may require smoke dampers. In addition, a fire damper or combination smoke and fire damper is required for an opening. Stair enclosures and vertical shafts are to be constructed to limit air leakage. Penetrations in shaft walls should be sealed. Exterior wall construction should limit air leakage. Seal penetrations and cracks in exterior walls and seal cracks around windows and doors. For small openings in smoke barriers, cracks, joints, etc., maintain an adequate pressure difference across the smoke barrier with the positive pressure outside the smoke zone. For large openings in smoke barriers, such as doors designated to be open, maintain an adequate air velocity across the smoke barrier with the air flow direction into the smoke zone.

F.6.2 Component Testing

Individual components shall be tested to determine if they are functional.

F.6.3 Ducts

Ductwork and supports may be designed and constructed in accordance with SMACNA's *HVAC Duct Construction Standards, 2nd Edition, 1995.* When specified, ducts shall be leak tested in accordance with SMACNA's *HVAC Air Duct Leakage Test Manual, 1st Edition, 1985.*

F.6.4 Escalators

Provide a smoke-control system to limit the spread of smoke through escalator openings. The escalator shaft may be provided with a smoke control system which will activate the exhaust system of the floor involved in the fire and cause adjacent stories to go to a supply only mode. Another method is to provide devices to close off the escalator shafts.

F.6.5 Exhaust Fans

Select fans certified by the manufacturer for maximum design temperature, tested in accordance with ANSI/ASHRAE Standard 149-2000, *Laboratory Methods of Testing Fans Used to Exhaust Smoke in Smoke Management Systems.*

F.6.6 Exhaust Outlets

Locate exhaust outlets to minimize reintroduction of smoke into the building and to limit exposure of the building or adjacent buildings to an additional fire hazard.

F.6.7 Fans

Fan should be selected for stable operation under normal conditions and, where applicable, for maximum design temperature. Adequate service factors should

be used for belt drives and motors. Noncombustible components should be used to support and restrain fans.

F.6.8 HVAC Systems

The smoke control system must include the effects of the HVAC system on both smoke and fire spread. Smoke control for the HVAC system will be automatically operated by activation of the sprinklers or smoke detectors. It must have the capability of manual override. Place fan and damper controls in clearly identified location approved by the fire department. Fire dampers are required in shaft walls, area separation walls and occupancy separation walls of two-hour or greater fire resistance. Where fire dampers are within air ducts which are a part of an engineered smoke control system, fusible links shall have a temperature rating of approximately 50°F (28°C) above the operating temperature for which the smoke control system is designed, but not to exceed 350°F (177°C). Fire dampers shall not be remotely or manually operable when the temperature at the damper exceeds that of the fusible link. Locate smoke exhaust or other HVAC discharge openings to minimize the probability of reintroduction of combustion products into the building. In low temperature climates, locate air inlets and exhausts so that snow or ice does not block the air passages.

F.6.9 Number of Open Doors

Consider the number of doors that may open simultaneously and how long they may be open. Generally, this will depend on the building occupancy and type of smoke control system.

F.6.10 Outside Air Inlets

Locate outside air inlets to minimize the potential for reintroduction of smoke or flame into the building.

F.6.11 Power Systems

The smoke control systems should be furnished with two power sources. One is the normal building power system and the other is an independent, automatically controlled power source.

F.6.12 Smoke Barriers

Construct and seal smoke barriers to limit leakage areas. Smoke barriers may have selected openings protected by closing devices or adequate airflows which serve to restrict the passage of smoke.

F.6.13 Smoke Management by Air Flow

Airflow can be used to inhibit smoke migration through openings such as doorways if the air has sufficient velocity to (1) prevent smoke from leaving the zone (the flow of air is into the smoke zone from adjacent areas), and (2) not be overcome by wind or stack effect. Because the qualities of air required are large, air flow is not usually a practical means of controlling smoke movement.

F.6.14 Smoke Management by Dedicated System

Dedicated systems are intended for the purpose of smoke management only. Non-dedicated systems share components with HVAC systems and convert to special operation mode for smoke control. Pressurized stair systems and atrium smoke management systems are examples of dedicated smoke management systems.

F.6.15 Smoke Control by Differential Pressure

A means of controlling smoke movement is by creating an air pressure differential across partitions, floors, and other building components. The principal of pressurization is to establish a higher pressure in adjacent areas than in the smoke zone.

F.6.16 Smoke Detection Systems

Install smoke detectors in the main return or exhaust duct serving each smoke zone and locations required by code. See Appendix F for more information of smoke detectors in duct applications.

F.6.17 Smoke Exhaust Shafts

Install combination fire and smoke dampers in the exhaust shaft openings at each floor level. The dampers are designed to be normally closed and may open automatically at the fire floor level to permit the removal of smoke from that floor.

F.6.18 Stack Effect

The smoke control system is to include consideration of the maximum probable normal or reverse stack effect. Altitude, weather history, building elevation, wind currents, and interior temperatures are used to calculate stack effect.

F.6.19 Stair Enclosure Pressurization

Stair enclosure pressure, with all doors closed, shall be higher than the adjacent floor space. Stair enclosure

pressurization may require that air be introduced at multiple levels. To avoid too great a force on the doors which would prevent them from opening, the maximum differential pressure between the stair and the space must not exceed 0.35 inches of water. The maximum force required to open a stair door under maximum stair pressure conditions should be limited to 30 lbf.

F.6.20 Temperature Effect

Temperature effect varies with building height, configuration, construction, and leakage, and openings in the walls and floors. The smoke management system must be capable of overcoming any adverse conditions caused by temperature effect.

F.6.21 Wind Effect

The smoke management system must be designed to be capable of overcoming any adverse effects of the wind.

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Telephone: 847-394-0150

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American Society of Heating, Refrigerating and Air Conditioning Engineers
1791 Tullie Circle, NE
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